JANUARY, 1953

HEATING AND VENTILATING

INCLUDING AIR CONDITIONING – PIPING – REFRIGERATION – AIR SANITATION

Lighting as Related to Air Conditioning page 101

A New Monthly Feature—

H & V's DETAIL SHEETS — See Pages 9 and 10

FOR CLASSY SHOPS

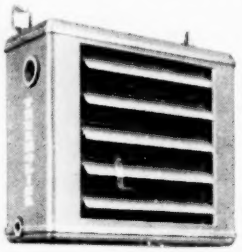
. . . OR BUSY PLANTS

THERMOLIER UNIT HEATERS

The condensed table below is a quick guide to the selection of the correct Thermolier for specific conditions. The capacities, when motors are operating at normal speeds, are based on Standard Basis of Rating: 2 lb. steam pressure and 60 F entering air temperature. Grinnell Thermoliers are tested and they are rated in strict accordance with rules of the Industrial Unit Heaters Association.

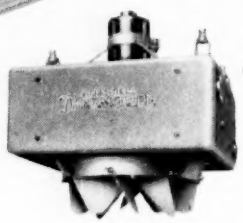
All Thermoliers can be operated at working steam pressures up to 125 psi and steam temp. up to 406 F.

A MODEL AND SIZE FOR EVERY PURPOSE

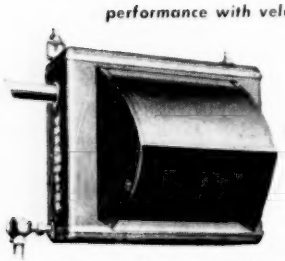


horizontal delivery

textile (horizontal delivery)



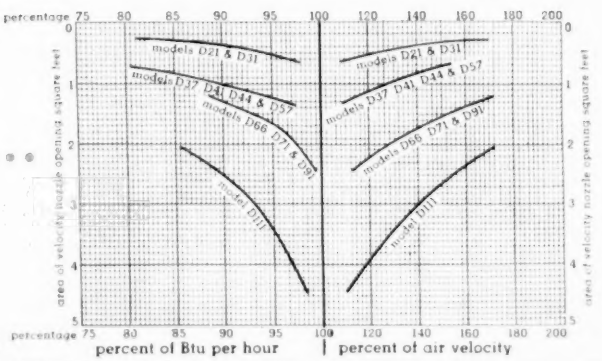
vertical delivery



velocity nozzle (horizontal delivery)

model	total heat delivered, Btu per hr	sq ft edr (nominal)	air velocity at exit, louvers open, lin. ft. per min.
horizontal delivery			
D21	35,600	148	786
D31	48,700	203	851
D37	62,200	259	753
D41	71,000	295	901
D44	84,100	350	887
D57	101,300	422	1016
D66	128,700	536	779
D71	151,700	632	977
D91	196,000	817	985
D111	275,300	1147	1048
Textile			
TX70	69,800	291	826
TX110	113,700	474	877
vertical delivery			
VA1042	50,800	212	1399
VA1045	73,600	307	1287
VA1065	109,400	456	1354
VA1075	145,600	607	1231
VA1101	185,000	770	1495
VA1111	257,000	1071	1631

performance with velocity nozzle ▶


percentage 75 80 85 90 95 100 120 140 160 180 200
models D21 & D31
models D37 D41 D44 & D57
models D66 D71 & D91
model D111
models D21 & D31
models D37 D41 D44 & D57
models D66 D71 & D91
model D111
area of velocity nozzle opening square feet
percent of Btu per hour
percent of air velocity

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THERMOLIER UNIT HEATERS

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Thermolier unit heaters • Grinnell-Saunders diaphragm valves • prefabricated piping • Grinnell automatic fire protection systems

Fume Removal
NO HEADACHE AT BAYER ASPIRIN PLANT

Photo courtesy of The Bayer Company Division of Sterling Drug, Inc.

In designing the beautiful new Bayer pharmaceutical plant in Trenton, N. J., engineers had to choose the best method of exhausting fumes from the filters. Their prescription: 20 DeBothezat stainless steel Bifurcator Fans installed in ducts right above the filters. Each Bifurcator has a 16" fan wheel with ½ HP motor and exhausts 2450 CFM at ⅜" SP. This method of fume removal protects workmen and equipment and helps maintain the conditions of strict quality control under which Bayer Aspirin is produced.

Choice of Materials — Bifurcators can be constructed of cold rolled steel, stainless steel, rubber coated steel, monel metal and many other corrosion-resistant materials.

Many Sizes — Bifurcators are available in a wide range of sizes and capacities, delivering from 913 cubic feet of air per minute (12" diameter fan with 1/20 HP motor) up to 45,000 cubic feet of air per minute (48" diameter fan with 20 HP motor).

If you have a fume removal problem, investigate DeBothezat Bifurcators. Write or ask your DeBothezat representative for new illustrated catalog.

Here's How **THE BIFURCATOR FAN WORKS . . .**

The DeBothezat Bifurcator is a direct motor-driven fan with a divided housing. Corrosive fumes are by-passed around the motor, which is mounted in a separate chamber, open to atmosphere but isolated from exhaust fumes.

DeBothezat Fans

Division of American Machine and Metals, Inc.

EAST MOLINE, ILLINOIS

Nature Controls the Heat in these Schools

James Solomon Russell School, Brunswick County, Va. Total square footage — 67,356. Cost — $524,870. Heating Contractors: W. J. Bloomfield & Son, Inc., Farmville, Va.

Dixon & Norman, Virginia architectural firm specializing in schools, specify Webster Moderator Systems for efficient heat in open-plan buildings fed by long steam lines.

"Nature makes the weather, let her operate the controls" — so say Dixon & Norman, Richmond architects and engineers. For comfort and economy, in all of their larger schools, they use centrally controlled, continuous flow steam heating systems.

"Many of our schools are also used for community activities," Dixon & Norman point out. "Classrooms are larger than average and auditoriums, gymnasiums and shop areas are in separate wings. Despite long steam lines, there is balanced heat distribution because the Moderator System delivers heat evenly and rapidly to every section of a building."

For information about Webster Products for school heating, call the Webster Representative or write us.

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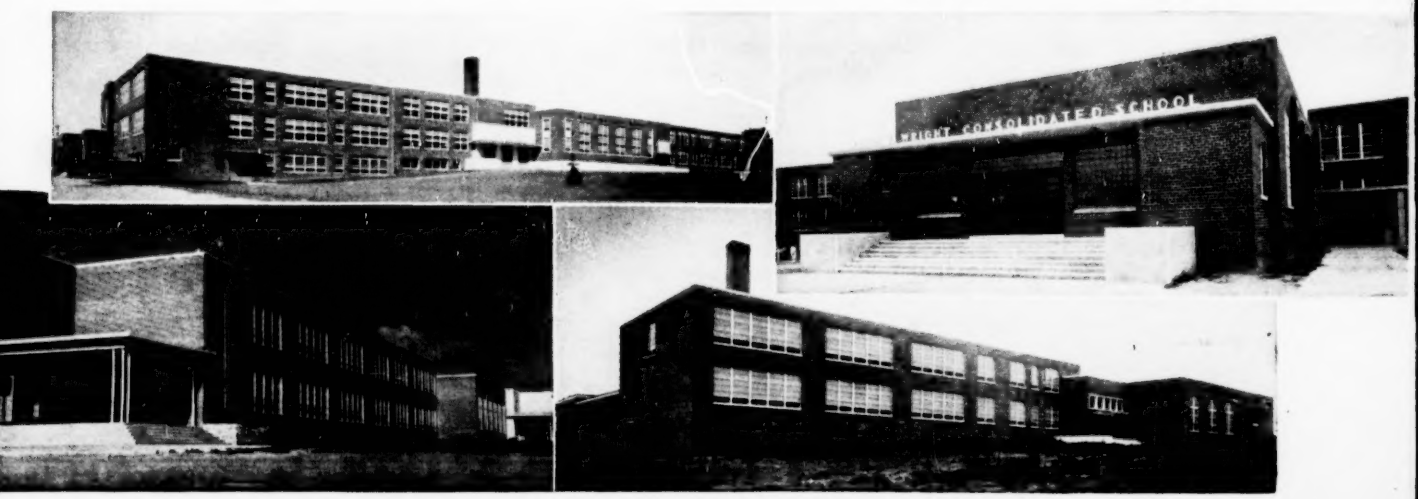
Camden 5, N. J. Representatives in Principal U. S. Cities

In Canada, Darling Brothers, Limited, Montreal

WEBSTER
MODERATOR
SYSTEM
OF STEAM HEATING

"Controlled by the weather"

TOP LEFT: Hermitage High School, Richmond. Heating Contractors: W. H. White, Plumbing & Heating, Richmond. TOP RIGHT: John J. Wright School, Spotsylvania County, Va. Heating Contractors: W. J. Bloomfield & Son, Inc. BOTTOM LEFT: Montevideo High School, Montevideo, Va. Heating Contractors: J. H. Cothran Co., Inc., Altavista, Va. BOTTOM RIGHT: Union High School, Caroline County, Va. Heating Contractors: J. H. Cothran Co., Inc.



HEATING AND VENTILATING

A MONTHLY MAGAZINE FOR ENGINEERS AND CONTRACTORS CONCERNED WITH THE DESIGN AND APPLICATION OF AIR CONDITIONING, REFRIGERATION, PIPING, AIR SANITATION, HEATING AND VENTILATION IN BUILDINGS

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The Contents of HEATING AND VENTILATING are indexed monthly by Industrial Arts Index and by Engineering Index, and are microfilmed by University Microfilms, Ann Arbor, Michigan.

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The Industrial Press

Also Publishers of
HEATING & PLUMBING EQUIPMENT NEWS
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THIS MONTH'S COVER

The field of retailing is dependent on adequate lighting to properly display the merchandise for sale, and satisfactory air conditioning to supply physical comfort for those in the selling area. For a discussion of lighting applications, good lighting design, and its relation to the air conditioning load, see page 101.

Washington News

LORING F. OVERMAN

WASHINGTON was experiencing the transition jitters as it awaited a new Congress on January 3, and a new Administration on January 20.

The controls agencies—price, wage and materials—were operating with dwindling staffs and temporary bosses. The retiring President was becoming increasingly petulant. Critics were predicting dire things for any administration which did not continue bootstrap prosperity supports.

Even some of those who had voted "for a change" were stating publicly that Ike alone could not be expected to do everything by himself, and that Business would have to put its collective shoulder to the wheel if it hoped to avoid a serious recession.

Economists Optimistic

A timely New Year's present under such conditions was the optimistic 70-page report issued by the staff of the Congressional Joint Economic Committee. The report discounts pessimistic predictions about what might happen to business when present heavy defense expenditures taper off. The report observes that the possible threat of the ultimate decline in the rate of defense expenditures "pales into insignificance beside the overriding forces on the horizon making for growth in the national economy during the years, and decades, ahead."

"The fact is," the report continues, "that the dynamic forces for growth in the national economy during the late 1950's give prospect of surpassing anything that the peacetime world has witnessed for several generations."

The report concedes that there will be challenging problems, but that opportunities for economic stability and growth will be present and that satisfactory economic adjustments can be made. Comments from the report—some of them of direct interest to the readers of Heating and Ventilating—include:

"It would be a tragic mistake to base our confidence in the economic outlook on the high level of Government expenditures for defense. There are other more powerful forces sustaining the economy at high levels. Foremost of these is population growth in the United States. In 1937 the population to be fed, clothed, and housed was expected to increase on the average by some 900,000 persons per year over the then succeeding decade or decade-and-a-half. Today, conservative estimates place the anticipated average annual increase for the next decade at twice that figure. If the population by 1960 reaches the seemingly probable level of 175,000,000, it will mean an increase during the decade of the 1950's of approximately 24 million as compared with about 19 million during the 1940's. It is of vital importance that an increase in productivity accompany the increase in population.

"To house the increased population and not lower present standards, housing requirements for the remainder of the 1950-60 decade will average at least as high as the annual average constructed during the 'good years' 1947 to 1952.

School and Hospital Outlook

"In the decades between 1930 and 1950, while the general population was rising, the number of pupils enrolled in the public elementary and secondary schools remained substantially unchanged. In the decade between 1950 and 1960 we may expect an increase of more than 27% in the number of pupils enrolled. Based upon estimates of the Office of Education, $20 billion of additional school construction will be required to take care of the accumulated backlog, to offset depreciation, and to take care of increased enrollment.

"To meet minimum standards suggested by the Public Health Service Act, this nation will need to provide additional hospital beds in the amount of $14 billion, according to a detailed study of existing beds and needs by the Public Health Service, based on data submitted by various states."

It is estimated, the staff says, that the investment needs to be met by 1960 in areas listed in the report, will reach $500 billion at today's prices. The breakdown: housing $100 billion; producers' durable equipment and nonresidential construction, $300 billion; highways, $60 billion; schools and hospitals, $40 billion.

The report points out that this figure does not include any allowance for the undetermined investment opportunities in agricultural techniques or for needed public investment in fields other than schools, hospitals and highways.

In brushing aside the suggestion that curtailed defense buying would have serious repercussions, the report observes:

"The needs for readjustment will come upon us much less abruptly than at the end of World War II, and in the form of a gradual sliding downward to a plateau of still high-level defense expenditures. In 1944 Government purchases for national security purposes took 41% of the gross national product. Two years later the percentage had fallen to less than 9%. Present national security expenditures account for about 15% of the gross national product and are not expected to decline much below 10% after the defense build-up has been reached."

Construction Ban Eased

The most significant easing of NPA construction controls since the institution of the original Construction Order M-4 on October 26, 1940, was scheduled to become effective January 1, 1953. That date marked the removal of the ban on recreational, amusement and entertainment construction, together with relaxation of other construction regulations.

Under the new provisions of the Construction Order, builders previously denied the right to self-certify scarce materials, may now order specified amounts of steel and copper, but not of aluminum. Self-certification privileges will be extended to aluminum on May 1. The self-certifying process speeds ordering and eliminates much paper work.

NEVER Ventilate a Ceiling or Wall Space to the Inside...

If you do, the better the insulation, the worse will be the condensation; for the colder the air in the space between insulation and roof, or walls, the less vapor can it support.

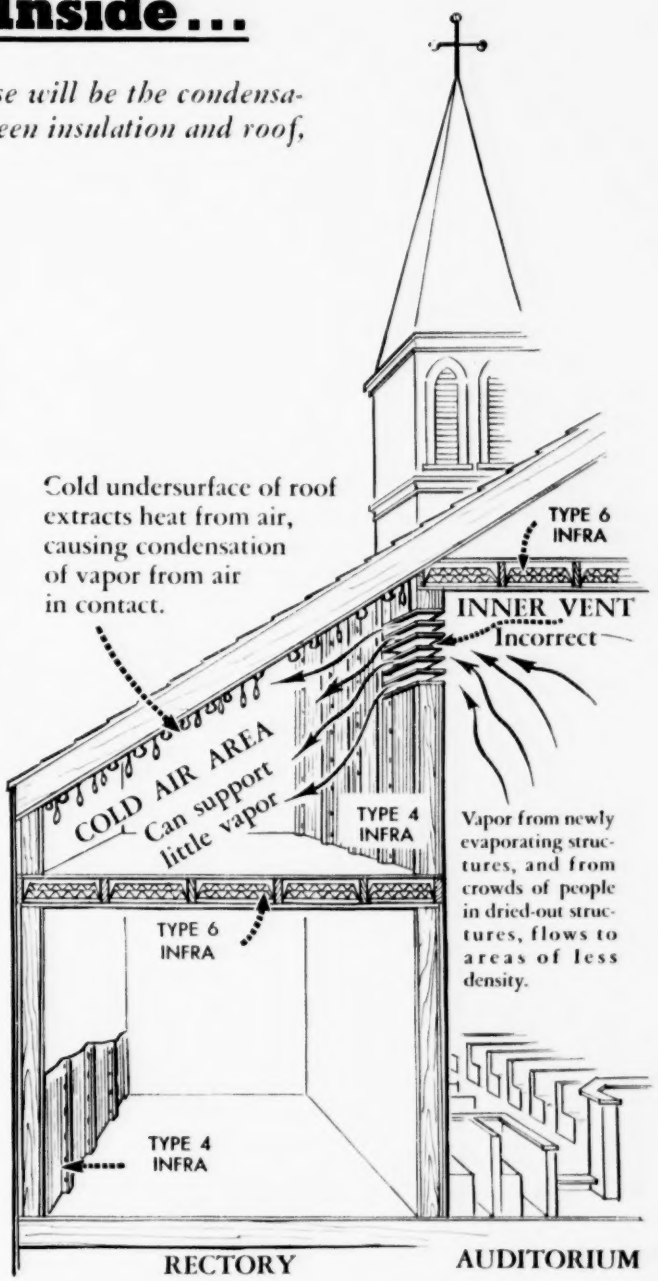
In new construction, thousands of tons of cement and plaster are evaporating. Vapor flows from areas of greater density into this small, cold space, an area of less vapor density and small capacity.

Multiple sheets of accordion aluminum, because impervious to vapor, force out through exterior walls and roofs, ordinary amounts of fortuitous vapor formed from rain leaks, etc. With unusual amounts of vapor, as from crowds, in theatres, schools, stores, etc. provision should also be made to vent this vapor to the *outside*.

In the illustration, an actual case, it was recommended that the inner vents above the insulation be eliminated. More details about this frequent error and other data on vapor flow and condensation sent on request.

Three-sheet accordion aluminum, permanently separated by fiber partitions, is commercially available as Type 6 Infra, and costs less than 9¢ sq. ft., material with labor, installed between wood joists in new construction.

Get valuable FREE copy of new, revised "Simplified Physics of Vapor and Thermal Insulation," authoritative, simply written 56-page manual. Covers heat and vapor flow, condensation, radiant heating, radiation, convection and conduction. Tells how to test insulations yourself and experiment with heat flow. Contains chart of *k*, C, R, and U factors of all insulations, of all thicknesses, weights, densities.


Cold undersurface of roof extracts heat from air, causing condensation of vapor from air in contact.
TYPE 6 INFRA
INNER VENT Incorrect
COLD AIR AREA Can support little vapor
TYPE 4 INFRA
Vapor from newly evaporating structures, and from crowds of people in dried-out structures, flows to areas of less density.
TYPE 6 INFRA
TYPE 4 INFRA
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Up-Heat	**C.089, R 11.23**	**= 4 3/5" dry rockwool**
Wall-Heat	**C.073, R 13.69**	**= 5 5/8" dry rockwool**
Down-Heat	**C.044, R 22.72**	**= 9" dry rockwool**

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The construction order has been eased progressively during the last few months, starting with June 18, 1952. On that date, NPA increased self-certification of aluminum and copper for such uses as schools, hospitals, public buildings, small dwelling units, industrial and consumer products, and commercial construction in order that small users could obtain their materials without filing applications.

On July 9, NPA granted permission to commence construction where an applicant had enough carbon steel on hand to complete his building project. It applied to all types of construction other than recreational, entertainment, and amusement.

On October 3, NPA announced that on May 1, 1953, the ban on recreational construction would be lifted. Advancement of the date to January 1 is in accord with the recommendation of a task force group of the construction industry's Industry Advisory Committee.

CMP Second Quarter Allotments

Second-quarter allotments of steel, copper and aluminum take into consideration the likelihood that there will be another million housing starts in 1953. In the consumer goods field, the second quarter steel allotments will be about 16% higher than the third quarter, but copper and aluminum allotments must remain at present levels because of continuing supply difficulties. Manufacturers of civilian type products will receive 70% of the steel used during a pre-Korean base period—50% of the copper and 55% of the aluminum.

Business and the Atom

With development and utilization of the atom becoming one of the Nation's largest enterprises—at least from the standpoint of investment in plant capacity—technical men of many industries were looking forward with interest to a series of early-1953 meetings involving the Atomic Energy Commission and the Joint Congressional Committee on Atomic Energy. Plans for the conferences were revealed in Washington in mid-December in a letter from AEC Chairman, Gordon Dean.

Initial developments in the field of commerce and industry promise to be in the realm of power production, AEC men indicate. There will be others, according to AEC Chairman Dean, but it may first be necessary to de-classify some of the data which the government considers top secret.

"We do not know yet what will be found in the new realms the cosmotron will open to us," said Mr. Dean, referring to a new cosmotron at Brookhaven National Laboratory, Upton, Long Island. "We do know that we are taking a great leap from earth-bound physics to the physics of the stars. Our experiments are no longer designed to control or isolate and study events that occur around us on the earth's surface. In high energy physics we are studying events that occur in nature only from cosmic causes."

How to modify the AEC policy of secrecy presents a difficult problem, Chairman Dean conceded. "The AEC," he said, "is faced with carrying out two contradictory responsibilities—security by secrecy, and security by achievement. The contradiction lies in the fact that secrecy imposed to keep knowledge from an enemy automatically inhibits the development of one's own technology. It is clear that in a short and violent war the emphasis should be on security by secrecy. It is also clear that in a long period of hostility without full scale war, the emphasis should be on security by achievement."

Saline Water Purification

Second in importance only to the atom program, according to Interior Secretary Oscar L. Chapman, is his department's research program directed toward the purification of saline and brackish water. The program, he said, is one that will affect the lives of many people in the United States and throughout the world.

Secretary Chapman reports that great strides toward solution of the problem have been made by schools and colleges, private industry, research organizations and individuals. He noted that a recent scientific publication lists the conversion of sea water as among the 10 most pressing engineering problems. The list includes such subjects as atomic energy, solar energy, products from sea water, etc.

Secretary Chapman is urging that the program be placed on the full $400,000 a year basis authorized by Congress earlier this year in Public Law 448. The law provides "for research into and development of practical means for the economic production, from sea or other saline waters, of water suitable for agricultural, industrial, municipal and other beneficial consumptive uses."

Report of a group of advisers investigating the project includes the comment that "it may well prove more economical to provide converted sea water than to continue reaching farther for fresh water supplies."

Reclamation Cost, $70 Million

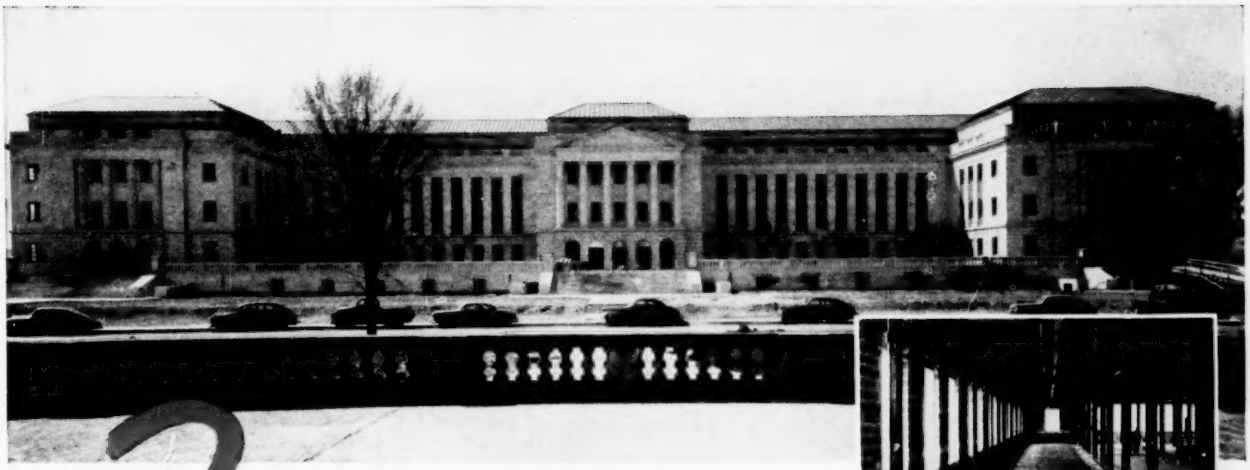
Considerable justification for the Interior Department's interest in lowering the cost of water supplies can be found in another announcement from that department. The first construction contract on a $70 million Weber Basin reclamation project has been let. The project, when completed, will furnish additional municipal, industrial and irrigation water for communities and farms on the eastern shores of Great Salt Lake, Utah, and other northern parts of the State.

The project is one of 10 "new construction starts" in the reclamation program authorized by Congress during the national emergency.

Home A-C Booklet Ready

Three associations active in the air-conditioning field have joined forces in completing a new booklet to be introduced on January 18 at the Builders Show in Chicago. The booklet, a checklist for builders, is entitled "Year-Round Air-Conditioning for Homes—a Suggestion for Builders". Cooperating associations are the Air Condtioning and Refrigeration Machinery Manufacturers Association, the National Association of Home Builders, and the National Warm Air Heating and Air Conditioning Association.

The sponsors explain that the booklet is intended as a check list; sort of an informal set of helpful standards. The booklet will make its first appearance as a section in the NAH Correlator.



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Architects—Meriwether, Marye & Associates
Lexington, Ky.
Engineers—Procter-Ingels Engineers Associated
Lexington, Ky.
Heating Contractor—B. A. Walterman
Cincinnati, Ohio

The established and continued acceptance of Byers Wrought Iron pipe for radiant heating systems is supported by thousands of past successful applications, and is constantly being confirmed by the growing number of current installations.

The two radiant heating installations covered here are typical of the confidence today's leading engineers hold for this time-proved material. In the Commonwealth of Kentucky's new $6 million Capitol Annex more than 24 miles of Byers Wrought Iron pipe was installed to safeguard the largest radiant heating system in a public building. And in "House of God," one of the largest radiant heated churches in the country, nearly 7 miles of 1½-inch Byers Wrought Iron pipe was laid in the church floor, steps and altars to provide the desired durability.

Write today for our bulletin, BYERS WROUGHT IRON FOR RADIANT HEATING.

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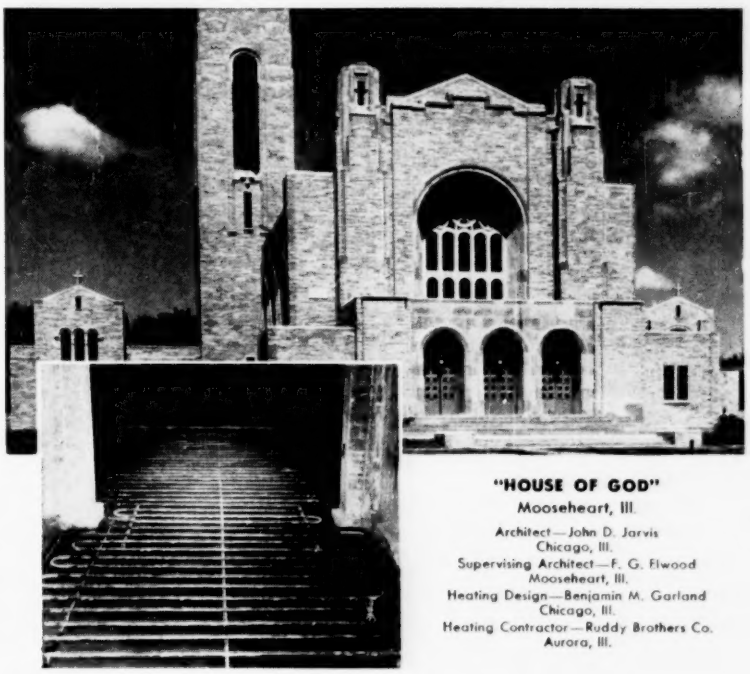

"HOUSE OF GOD"
Mooseheart, Ill.
Architect—John D. Jarvis
Chicago, Ill.
Supervising Architect—F. G. Elwood
Mooseheart, Ill.
Heating Design—Benjamin M. Garland
Chicago, Ill.
Heating Contractor—Ruddy Brothers Co.
Aurora, Ill.

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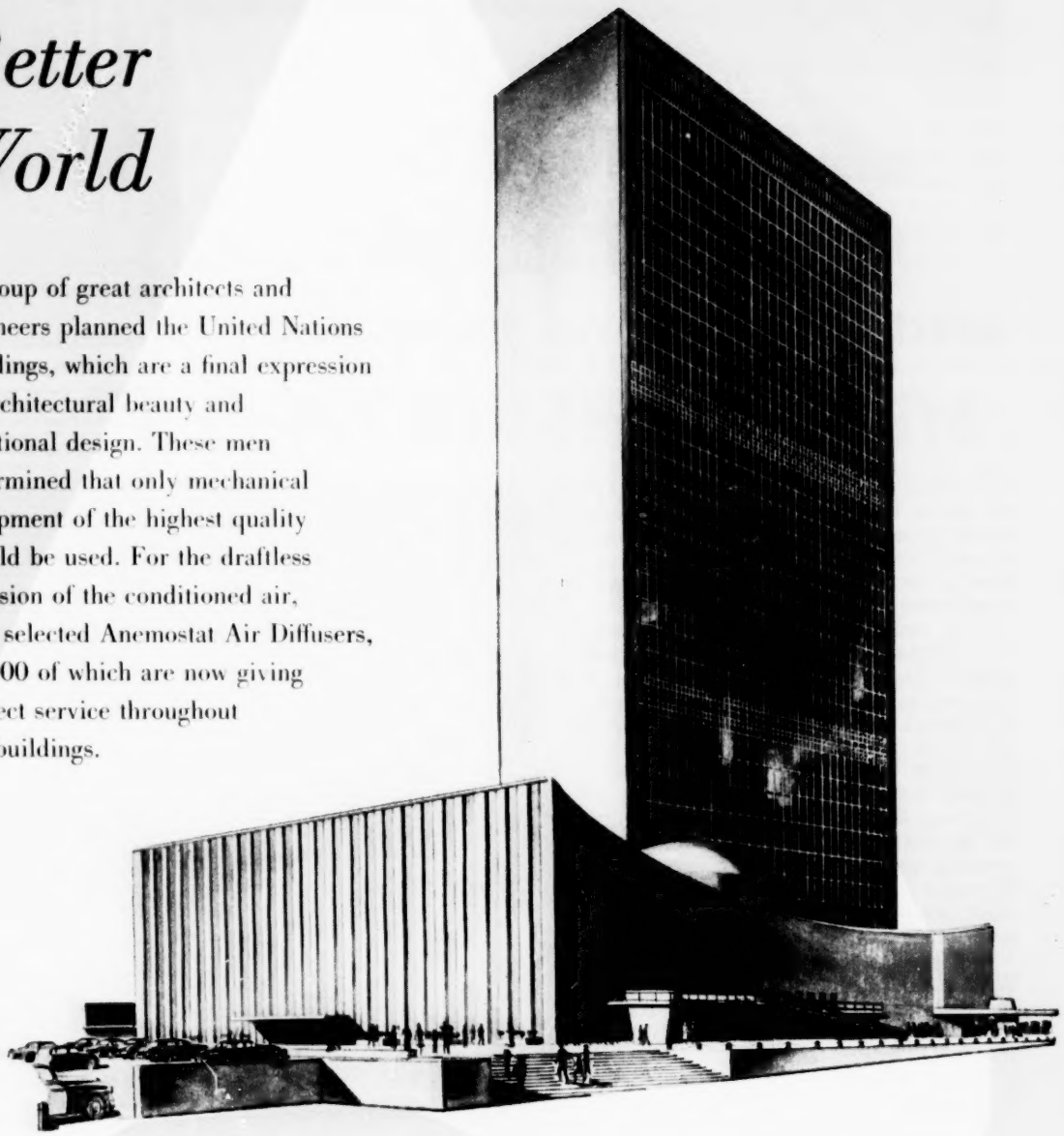

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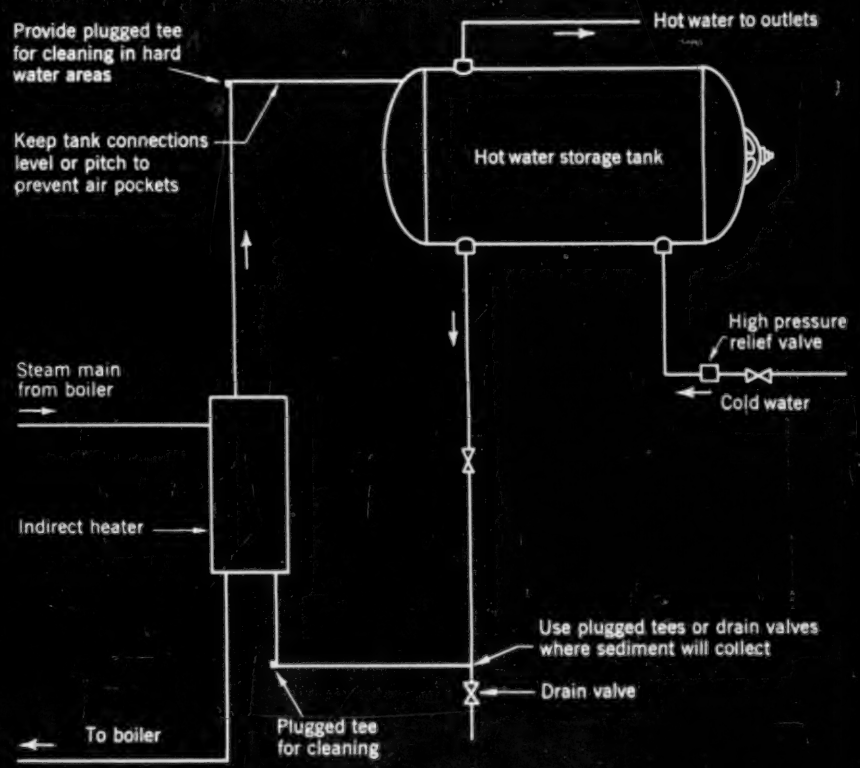
REPRESENTATIVES IN PRINCIPAL CITIES

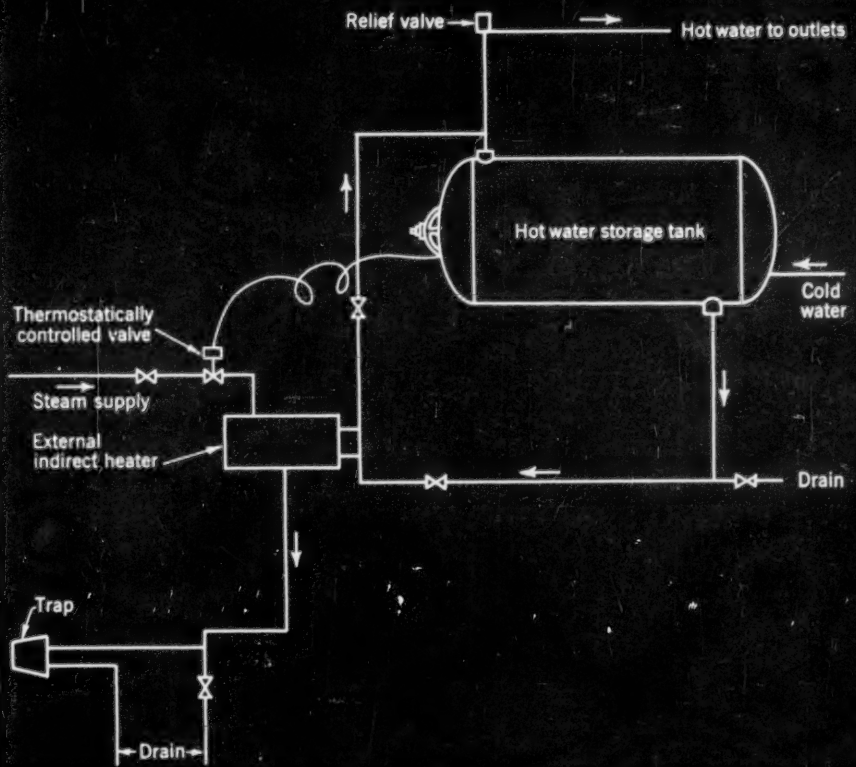
HEATING AND VENTILATING'S DETAIL SHEET

SERVICE HOT WATER PIPING

WITH STEAM AS SOURCE OF HEAT


Provide plugged tee for cleaning in hard water areas
Hot water to outlets
Keep tank connections level or pitch to prevent air pockets
Hot water storage tank
High pressure relief valve
Steam main from boiler
Cold water
Indirect heater
Use plugged tees or drain valves where sediment will collect
Drain valve
To boiler
Plugged tee for cleaning

STEAM SUPPLY FROM BOILER TO AN EXTERNAL INDIRECT HEATER

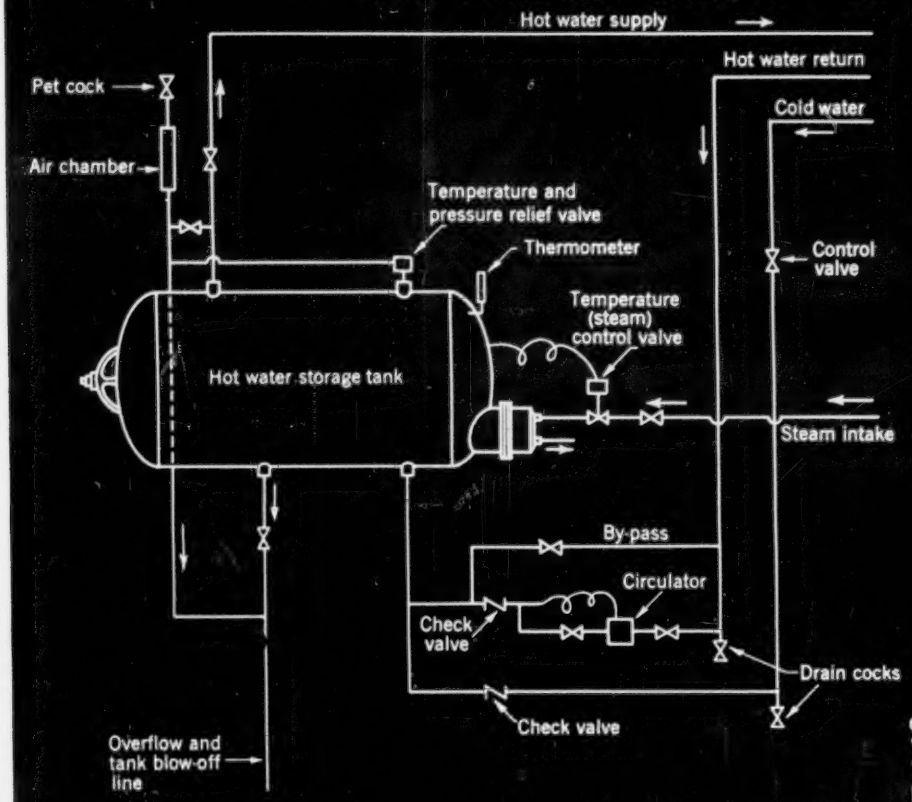


STEAM SUPPLY - THERMOSTATICALLY CONTROLLED - TO AN EXTERNAL INDIRECT HEATER

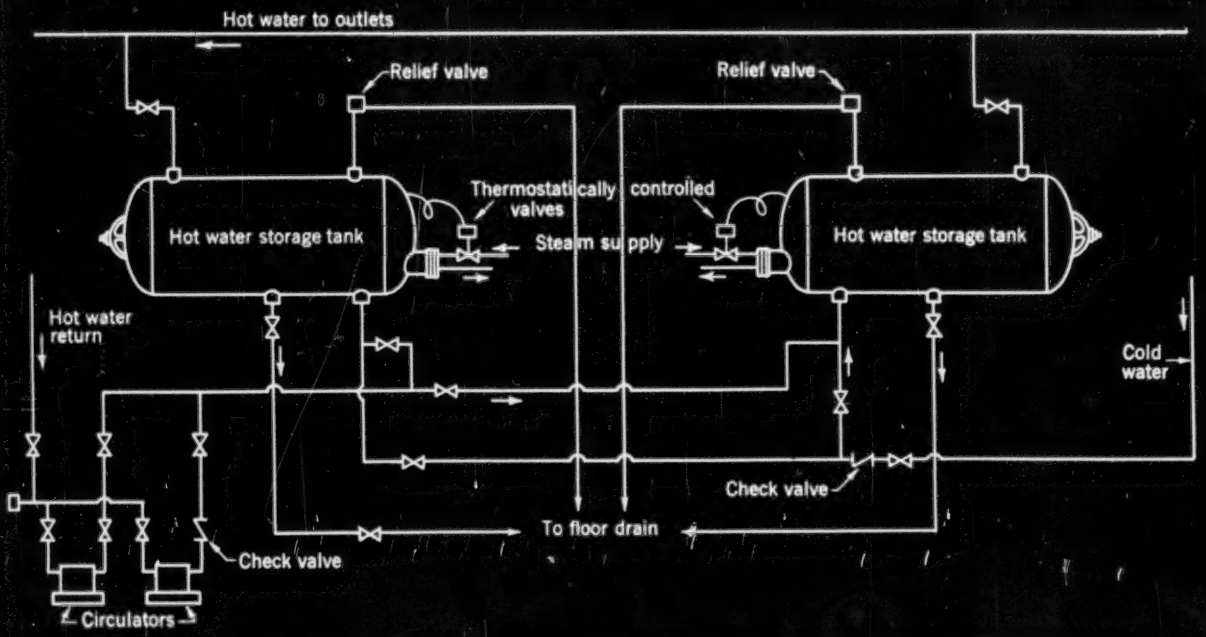
HEATING AND VENTILATING'S DETAIL SHEET

SERVICE HOT WATER PIPING

WITH STEAM AS SOURCE OF HEAT



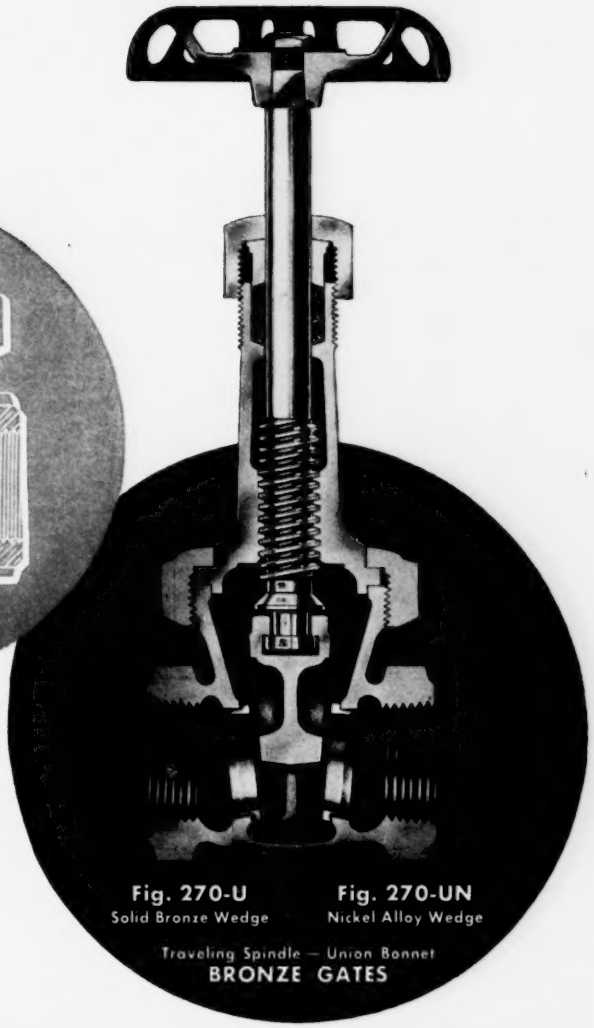
CIRCULATING HOT WATER SYSTEM WHERE STEAM IS AVAILABLE ALL YEAR. SUBMERGED INDIRECT HEATER USED.



SYSTEM WITH TWO STORAGE TANKS AND CIRCULATORS. STEAM SUPPLIED TO SUBMERGED INDIRECT HEATERS.

PIPING HOOKUPS THROUGH THE COOPERATION OF AMERICAN SOCIETY OF SANITARY ENGINEERING, NEW YORK CHAPTER; BELL & GOSSETT CO., MORTON GROVE, ILL.; GENERAL FITTINGS CO., PROVIDENCE, R.I.; SYSKA & HENNESSY, NEW YORK, N. Y.

Built-in $AVING$ make JENKINS BRONZE GATES your BEST BUY

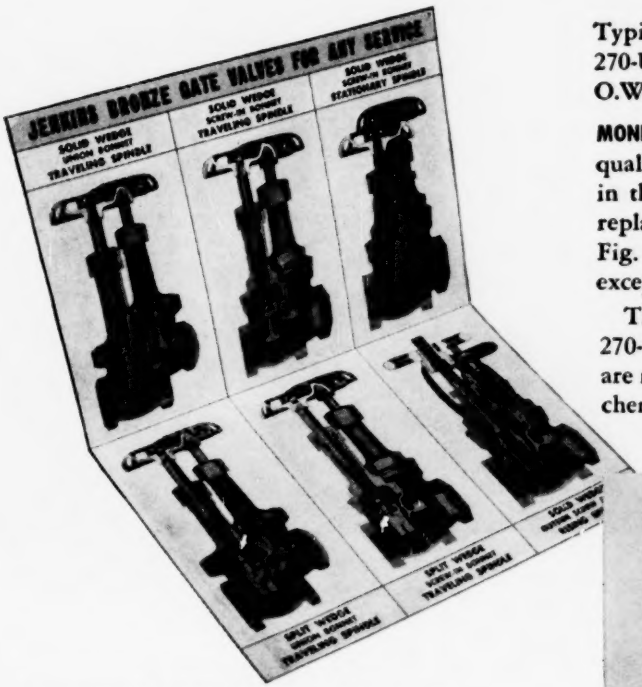


Look over any of the 35 patterns in Jenkins complete line of Bronze Gates. You'll find *savings* built into every valve. Jenkins valve specialists designed each one for easy maintenance and extra long wear. Try them on your toughest services and see why they take top-rating in any test for endurance and economy. Jenkins Bros., 100 Park Ave., New York 17.

Typical of Jenkins design for built-in savings are the Fig. 270-U and Fig. 270-UN Gates for 200 lb. Steam, 400 lb. O.W.G. services.

MONEL AND BRONZE SEATING COMBINATION In Fig. 270-U a high quality bronze wedge seats against MONEL rings expanded in the body. The wedge takes the wear — it can easily be replaced when necessary by slipping a new one on the stem. Fig. 270-UN, with a nickel alloy wedge, is recommended for exceptionally severe conditions of rapid wear and corrosion.

These and other features of rugged construction make Figs. 270-U and 270-UN first choice for economy where conditions are most destructive to valves, as in oil refineries, dye houses, chemical, food, and rubber plants.



Jenkins Bronze Gate folder shows the many types available — lists convincing reasons why they are your best buy for any service. Ask for Form 181-A.

JENKINS VALVES
LOOK FOR THE DIAMOND MARK
SINCE 1864 TRADE JENKINS MARK
Jenkins Bros.

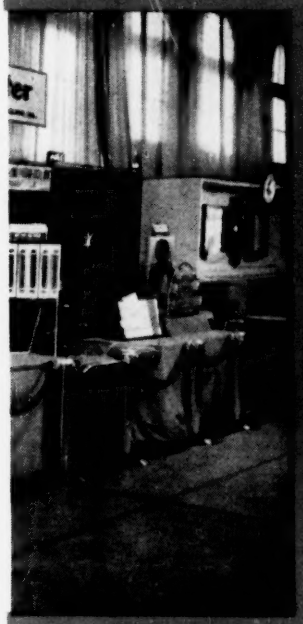
SOLD THROUGH LEADING INDUSTRIAL DISTRIBUTORS

Show Headquarters for Air Cleaning.

These photographs show the American Air Filter and Herman Nelson displays at the Philadelphia show.

American Air Filter
COMPANY, INC.
294 Central Avenue, Louisville 8, Kentucky

. . . Heating and Ventilating Equipment



We've planned our show for you. It will be bigger and better than the successful Philadelphia show . . . with more new things to see . . . more useful information . . . and more practical ideas for *your* business!

Here you will see the world's greatest and the only *complete* line of AAF Air Filters and Electronic Precipitators . . . all in one place.

Here, too, will be concentrated the great HERMAN NELSON line of Unit Heaters—Unit Blowers—Propeller and Centrifugal Fans and the exclusive DRAFT|STOP Unit Ventilators.

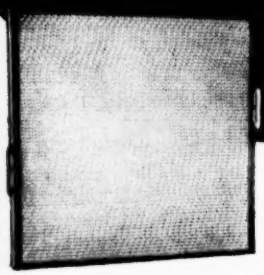
Plan To Make AAF Your Show Headquarters . . .
We'll Be Ready To Greet You.

AAF

herman nelson

BANISH HIGH AIR FILTRATION COSTS!

FAR-AIR* Filters Save You Money Four Ways!



Yes, you can have more efficient air filtration at less cost when you install FAR-AIR. These are the original high velocity filters and are "lifetime engineered" for economy and top efficiency. Remember these four ways to save the next time you buy or replace air filters:

Other FAR-AIR Products:

Self-Washing Filters
Kitchen Grease Eliminators
Engine and Compressor Filters
Rotary (Evaporative) Coolers
Air Baffle Equipment
Filter Servicing Equipment

Mail this coupon today!

FARR COMPANY
P. O. Box 10187, Airport Station, Los Angeles 45, California
Gentlemen: I would like full information on FAR-AIR filters.
I would ____ would not ____ like a Farr Field Engineer to call.

1+1=3

LOWER FIRST COST

FAR-AIR filters handle 50% more air per unit with less pressure loss than ordinary types. Thus two filters will do the work of three which means fewer units to buy originally plus the economy of smaller plenum chambers. Each FAR-AIR filter will handle *more* dirt and *more* air with *less* pressure loss and will give greater efficiency than other types of impingement filters.

60%

LESS MAINTENANCE

Because there are fewer filters required to do your job and because of the exclusive herringbone-crimp media design which allows each filter to hold more dirt, cleaning frequency is drastically reduced—over 50%! Maintenance is faster and easier, too, because of the free flushing characteristics of the media – a great saving in time and money.

GREATER EFFICIENCY

The exclusive herringbone-crimp design of FAR-AIR filters allows the dirt to load progressively through the entire filter, not just on the face. There is exceptionally low pressure loss even on a fully loaded filter because channels in the media allow passage of clean air. This gives you more efficient filtering under all dust conditions for longer periods of time.

LONGER

SERVICE LIFE

Excellence of construction protects your investment and insures that FAR-AIR filters will far outlast ordinary types. Here are some of the quality features.

Sixteen gage steel filter and holding frames assure well-aligned rigid filter banks. Reinforcing rods make distortion virtually impossible. Felt linings prevent air by-pass. Firmly packed media provides *permanent* even density and assures uniformly high efficiency over the entire filter area.

Truly, when you buy FAR-AIR filters you get more for your money *four* ways. It will pay you to investigate these filters now and cut your air filtration costs.

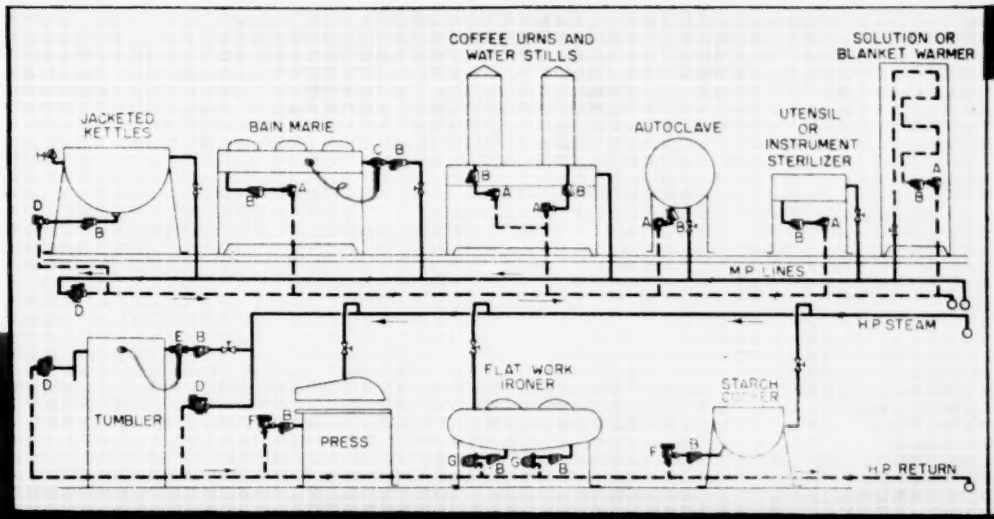
FAR-AIR FILTERS
"Better by Farr"

*Trade Mark

FARR COMPANY
Manufacturing Engineers
CHICAGO · LOS ANGELES · NEW YORK

Mf'd under license by Control Equipment Co. Ltd., Montreal, Canada

NAME _____ TITLE _____
COMPANY _____
ADDRESS _____

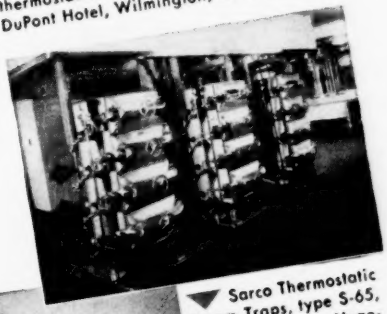


Series 52 No. 23

- **A** — S-65 Trap
- **B** — Strainer
- **C** — TR-19 Control
- **D** — Inverted Bucket Trap
- **E** — KR-14-MD Control
- **F** — 9-125 Trap
- **G** — Float Thermostatic Trap
- **H** — Air Vent

BUILDING SERVICE EQUIPMENT

S. Blickman Trunion Kettles equipped by manufacturer with Sarco thermostatic steam traps, type S-65, DuPont Hotel, Wilmington, Delaware.



Sarco Thermostatic Steam Traps, type S-65, on S. Blickman Vegetable Steamers at Prudential Insurance Co., Newark, N. J.

Sarco Inverted Bucket Steam Traps on large size jacketed kettles by Legion Utensil Co.

● BUILDING SERVICE EQUIPMENT is just one example of the many steam trapping problems encountered under one roof.

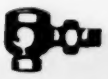
Sarco's four distinct types of steam traps make it possible to select the proper type for each application and yet all of the same manufacture.

That is why Heating Engineers and Piping Contractors prefer Sarco.

Undivided responsibility assures over-all satisfaction to the ultimate user — the objective of both the Engineer and Contractor.

Equipment manufacturers standardizing on Sarco Steam Traps and Controls do so with complete confidence, knowing Sarco will insure proper performance of their equipment.

Sarco Company, Inc., Empire State Bldg., New York 1, N.Y. • Sarco Canada Ltd., Toronto 8, Ontario.



Sarco Thermostatic Steam Trap for kitchen and hospital equipment, type S-65 to 65 psi, type N, 100 to 100 psi.

Sarco Float—Thermostatic Steam Trap

Liquid Expansion Steam Trap

Sarco Inverted Bucket Steam Trap.

SARCO saves steam

sarco quality assures satisfaction

422

Look for Economy
WHEN YOU BUY HEATING PUMPS

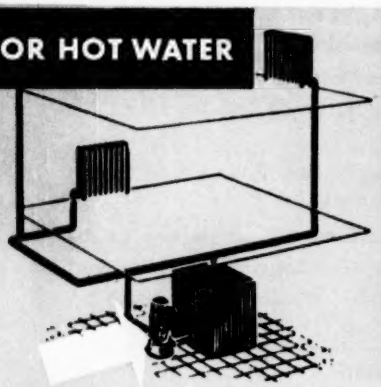
WHEELER-ECONOMY HEATING PUMPS
with Better-Than-Ever Engineering and Quality Control

With the consolidation of Economy Pumps, Inc. and C. H. Wheeler Manufacturing Company, the heating pumps you have always bought as "the best in the field" will now be sold as WHEELER-ECONOMY HEATING PUMPS. Representatives are being appointed in key areas to give you good service with a time-honored line of heating pumps that is now *better than ever.*

The Wheeler-Economy line of heating pumps has undergone a complete engineering check-up and reanalysis from the castings out. Many refinements have been made and a new face-lifting has been effected . . .

TYPES FOR EVERY BASIC HEATING PROBLEM

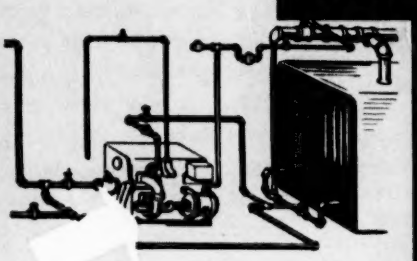
FOR HOT WATER



HOT WATER CIRCULATION

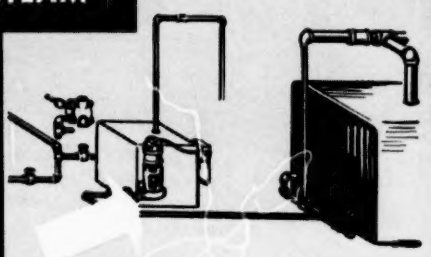
Wheeler-Economy Pumps deliver hot water to radiators quickly and return warm water to boiler with minimum heat loss.

FOR STEAM



STEAM VACUUM

The Wheeler-Economy Vacuum Producer is the most efficient design ever devised for removing air and water from condensate return lines.



RETURN CONDENSATION

Wheeler-Economy Pumps combine outstanding performance with low power cost in a compact dependable design.

WHEELER-ECONOMY HOT WATER CIRCULATING PUMPS

Type SCV—Vertical direct connected centrifugal pump. Sizes 1" to 3". Capacities to 500 GPM. Various RPM speeds 1150 to 3450. Heads to 225'.

Type SCC—Close coupled vertical or horizontal mounted. Sizes 1½" and 2". Capacities to 100 GPM. 3450 RPM. Heads to 120'.

TYPE SCV

TYPE SCC

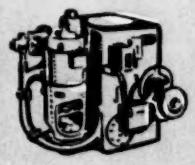
WHEELER-ECONOMY VACUUM PUMPS

Type VV—Vertical Vacuum Pumps—Suitable for use on all ordinary jobs operating between 3 and 12 inches of vacuum. Made for all discharge pressures up to 150 lb. per sq.in. Capacity sq.ft. E.D.R. 2500 to 15,000. Single and duplex units.

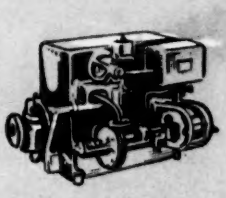
Special Capacities—VVS and VVSD single and duplex units recommended wherever capacity of system or air leakage is greater than ordinary. Also where lifts or pockets in the returns necessitate carrying higher vacuum. (Example: 10 to 16 inches.)

Type SVA—Horizontal Vacuum Pumps—For ordinary jobs operating between 3 and 12 inches of vacuum. Discharge pressures up to 150 lb. per sq.in. Capacity sq.ft. E.D.R. 20,000 to 100,000. Single and duplex units.

Special Capacities—Styles SVS single unit and DVS Duplex Unit, recommended where air capacity or air leakage in the system is greater than ordinary. Also where lifts or pockets in return require the carrying of higher vacuum—example 10 to 16 inches.



TYPE VV



TYPE SVA

WHEELER-ECONOMY RETURN CONDENSATION PUMPS

Type E—Operate at 1750 RPM or for 50 cycle current at 1440 RPM. The best pump where extremely quiet operation is desired. Single and duplex units. Capacity sq.ft. direct C.I. radiation or equivalent: 1000 to 65,000.

Type EC—Available for the same or higher pressure than handled by Type E pumps. Operate at 3450 RPM. Units for 50 cycle current operate at 2880 RPM. Capacity sq.ft. direct C.I. radiation or equivalent 1000 to 65,000. Single and duplex units.

Vertical Underground Pump—Used where returns are below floor level or otherwise too low for horizontal pumps. Cast Iron tank can be installed flush with floor. No pit required for pump. Low and medium pressure units equipped with single stage pumps of vertical design. For higher pressure units a multistage pump of special design is used. Capacity in sq.ft. direct C.I. radiation or equivalent 2000 to 50,000. Single and duplex units.

Type S—Condensation Pump with Steel Receiver—An "Economy" installation where service is not severe and heavy construction cast iron tanks are not required. Where steel receiver is satisfactory and low cost is of primary importance Type S is recommended. However, these low cost models are the equal of the top grade in many competitive lines. Single or duplex units.

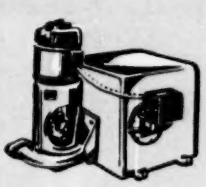
Type MR—Lightweight Pump for low pressure steam heating systems. Priced to meet competition . . . with no compromise in workmanship and materials. Capacities up to 65,000 sq.ft. E.D.R. Single and Duplex Units.

Types B and C—Horizontal Return Condensation Pumps—Type B multi-stage pump for pressures up to 150 lbs. 1750 RPM. Quiet operation. Capacities in sq.ft. direct C.I. radiation equivalent to 6000 to 65,000.

Type C multi-stage pump for pressures up to 175 lbs. 3600 RPM 60 cycle. Identical to type B except for higher speed operation. Capacities in sq.ft. direct C.I. radiation equivalent to 6000 to 65,000.

Type G—Horizontal Return Condensation Pump—Type G single suction, single stage designed for medium and high pressures at motor speeds 1800 to 3450 RPM. Receivers of all three types, "B", "C" and "G" are welded steel plate unless otherwise ordered.

All Wheeler-Economy Heating Pumps are tested before shipment and guaranteed for workmanship and materials.

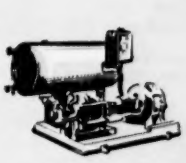


TYPES E & EC

TYPE U

TYPE S

TYPE MR



TYPES B & C

TYPE G

SOME TERRITORIES STILL AVAILABLE FOR REPRESENTATIVES WHO QUALIFY

Over 15 million dollars' worth of these pumps are in use throughout the United States

126

WHEELER-ECONOMY PUMPS

WHEELER-ECONOMY PUMPS, INC. A DIVISION OF C. H. WHEELER MANUFACTURING CO.

19TH AND LEHIGH PHILADELPHIA 32, PA.

PLAN *with* BALDOR

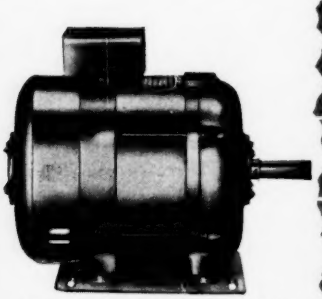
Your Engineering Staff PLUS Baldor Motor Specialists make a good strong team.

In planning new products and redesigning equipment, let the helpful cooperation of the Baldor Engineering Staff serve as a supplementary section of your own Engineering and Production Departments.

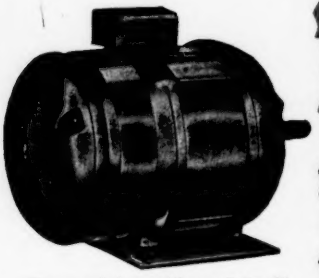
In our quarter-century of diversified motor-applications experience, we have probably solved — for other manufacturers — the very problems that now confront you on your drawing boards.

PLAN WITH BALDOR — the Better Motor for a Better Product.

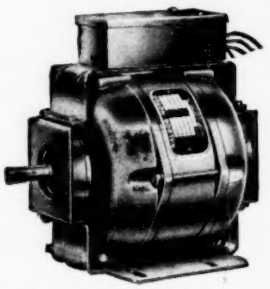
BALDOR ELECTRIC COMPANY, 4353 Duncan Ave., ST. LOUIS 10, MO.
District Offices in Principal Cities



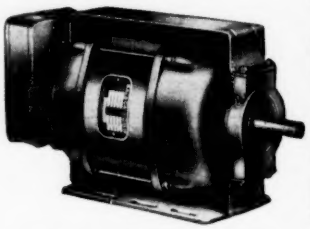
Open, drip-proof construction; 1/6 to 1/3 h.p., 1 phase, 3 phase and direct current.



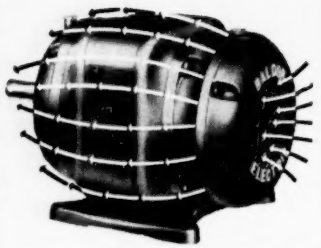
Streamcooled, round frame, 1/3 to ¾ h.p., 1 phase, 3 phase and direct current.



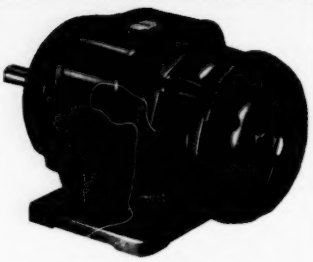
Resilient-mounted, open, drip-proof, for belt drive; 1/10 to ¾ h.p., single phase.



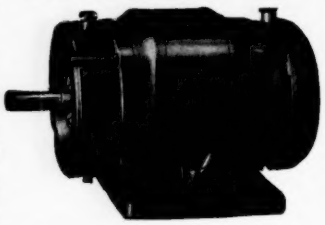
Resilient-mounted fan motor 1/30 to ½ h.p., 1 phase; ⅛ to ½ h.p., 3 phase.



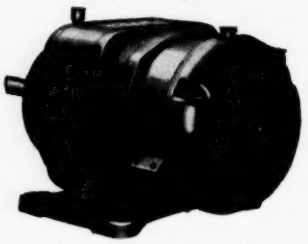
Streamcooled, polyphase, 1 to 20 h.p. (arrows indicate forced air cooling over entire exterior of motor frame).



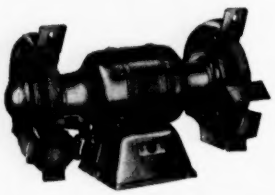
Streamcooled, single phase, ¾ to 7½ h.p.



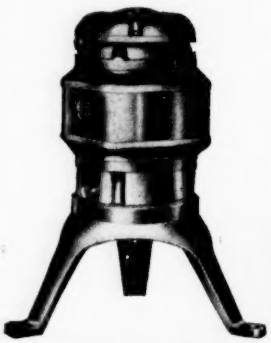
Streamcooled face mounted; 1 phase, 3 phase and direct current.



Streamcooled, direct current, 1 to 5 h.p.



Baldor builds a complete line of bench and pedestal type Grinders, 6" to 12" wheels, ¼ to 3 h.p., including a special Carbide Tool Grinder.

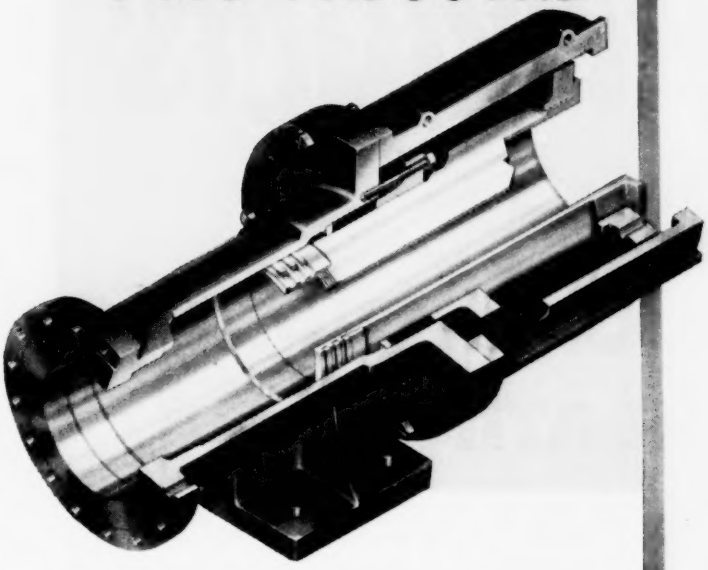


Streamcooled, face-mounted with tripod; for vertical mounting.

Baldor
BETTER MOTORS
FOR MORE THAN A QUARTER OF A CENTURY

ADSCO EXPANSION JOINTS...

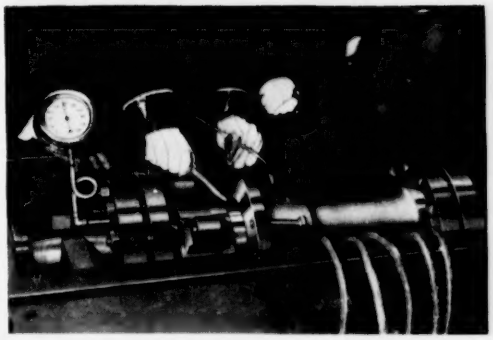
UNPACKED AT FULL PRESSURE



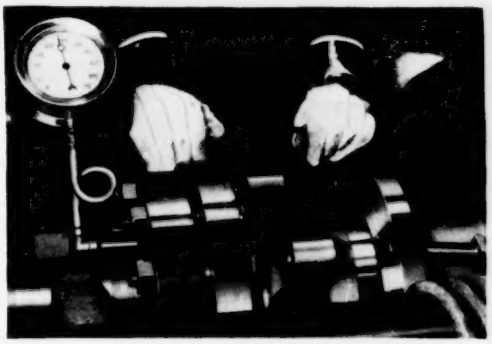
▶ ADSCO piston-ring expansion joints can be serviced . . . in fact, unpacked and repacked . . . under full line pressure. There is no interruption of service, no down-time for repacking, because the job is done under normal working conditions.

▶ Yet this isn't the only great feature of this high-quality joint. Slip is completely guided . . . split external guide permits smaller manholes . . . limit stops prevent over-travel of slip . . . polished surface cannot be scored because slip is in contact with packing only . . . misalignment is prevented by both internal and external guiding. ADSCO piston-ring expansion joints are available in a full range of sizes, with 4", 8", or 12" traverse per slip, for pressures to 400 psi and greater and for temperatures to 800F and higher. Call an ADSCO representative or write for Bulletin 35-15H.

. . . and here's proof



Last strand of packing being withdrawn from stuffing box.



Close-up photograph shows all packing removed. With steam at 240 lbs. pressure and with 300° superheat there is no trace of steam in the empty stuffing box.

With periodic adjustments of the gland, it may never be necessary to repack the stuffing box in an ADSCO piston-ring expansion joint. However, lack of maintenance may make it necessary at some time to do so and the job is easy with this ADSCO joint. The piston rings hold the line pressure during the unpacking and repacking operation. With the vent valve open, the vent chamber is at atmospheric pressure and, under this condition, no steam can enter the stuffing box space. Thus complete repacking can be done under full line pressure.

ADSCO ENGINEERED PRODUCTS

EXPANSION JOINTS
HEAT EXCHANGERS
STEAM TRAPS
STRAINERS
SEPARATORS
METERS

AMERICAN DISTRICT STEAM COMPANY, INC.

NORTH TONAWANDA, NEW YORK

Since 1877

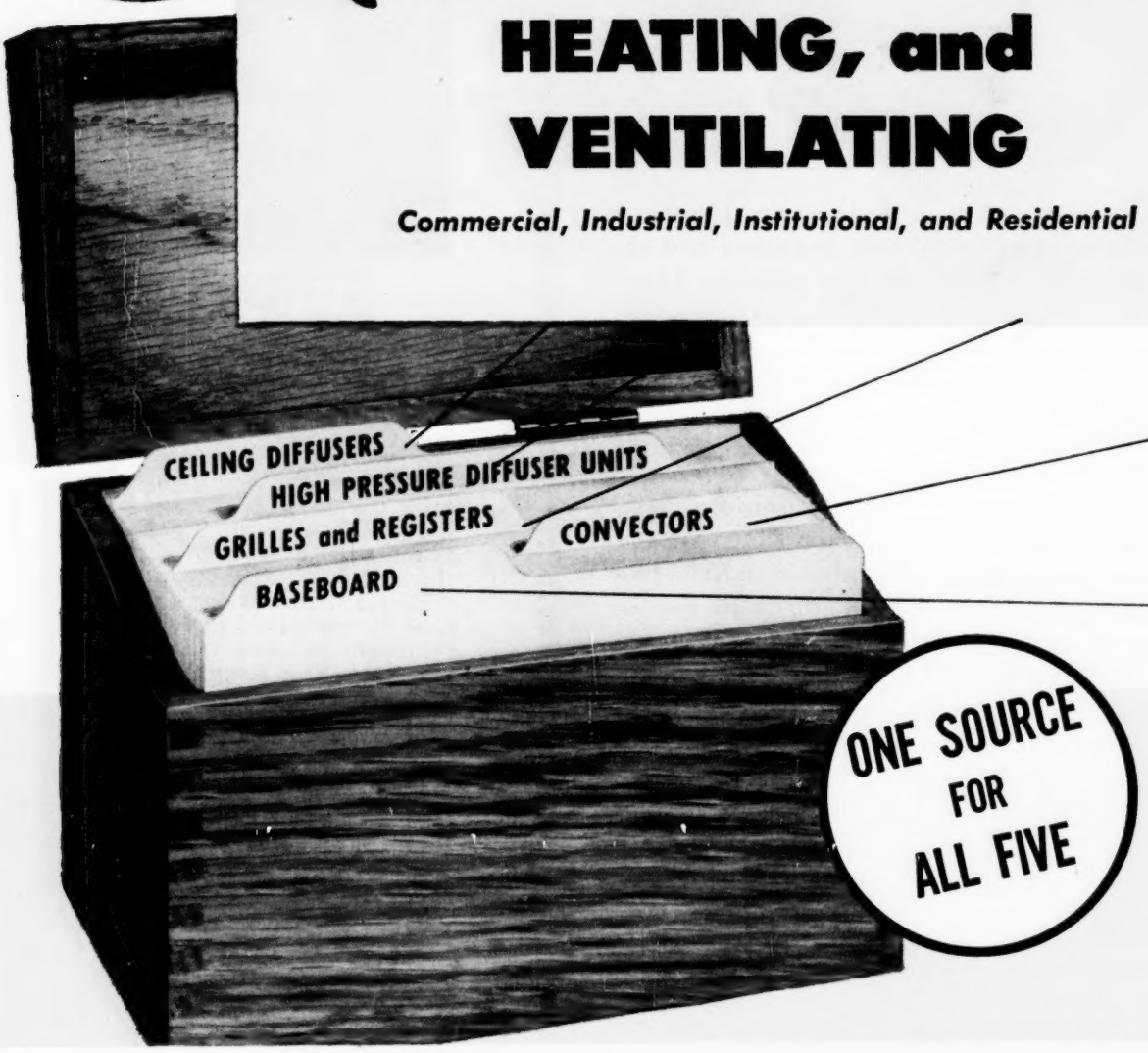
Engineered Products

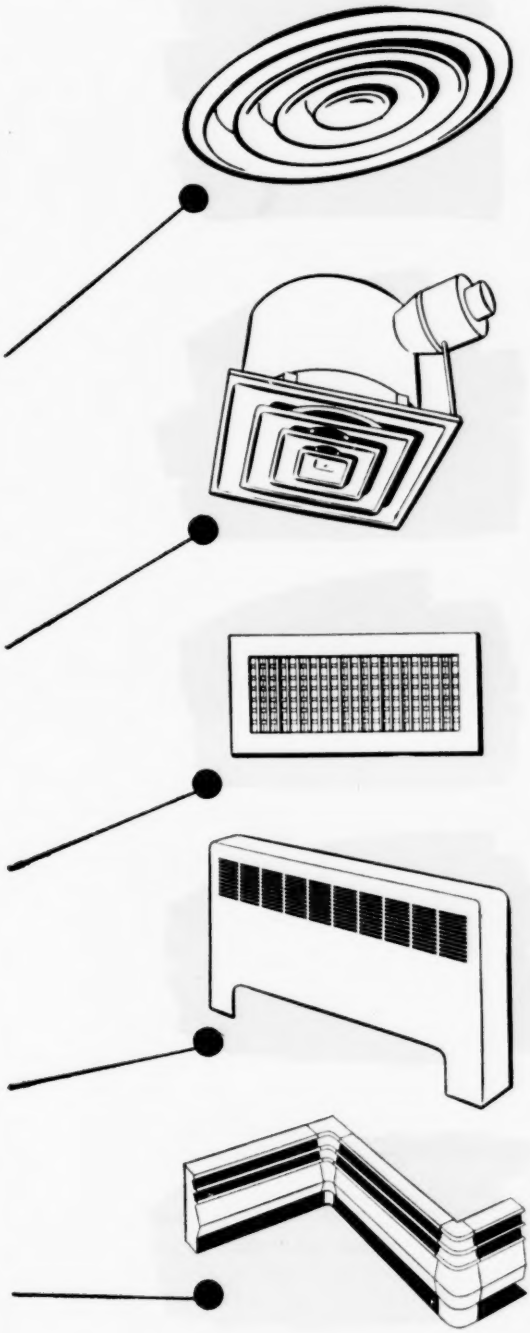
T & B

FOR

AIR CONDITIONING, HEATING, and VENTILATING

Commercial, Industrial, Institutional, and Residential





Aerofuse Ceiling Diffusers are installed at the vital point of air delivery in important buildings from coast to coast. A wide range of types and sizes to meet every requirement of appearance and performance.

T & B High Pressure Diffuser Units are the result of many years of laboratory experiment and practical experience in the field. Units now in operation handle branch duct velocities up to 3500 FPM, discharge air without noise or drafts.

Tri-Flex Supply Air Grilles and Registers . . . Aerovane Return Air Grilles and Registers. Standard sizes for economy and prompt delivery. Individually adjustable face bars. Registers equipped with opposed blade dampers.

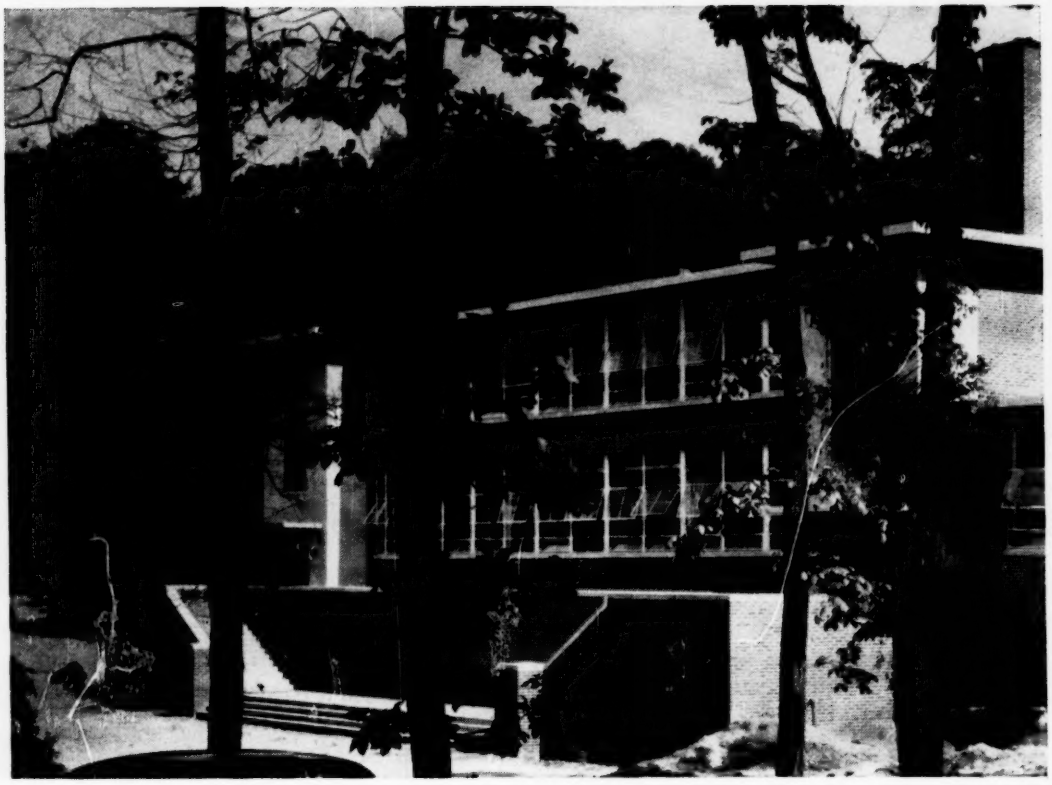
T & B Convectors are widely used in homes and apartments. Two types are available . . . Type R for recessed installation . . . Type F for free standing installation. Styled for beauty, engineered for comfort.

T & B Baseboard combines the heating comfort and smart appearance essential in the modern home. Two types . . . recessed . . . free standing . . . both designed with two-piece construction for ease of installation.

See the
TUTTLE & BAILEY
EXHIBIT
ASHVE Show, Booth 2-305

TUTTLE & BAILEY inc

NEW BRITAIN, CONNECTICUT



Architects and engineers, Warren, Knight and Davis, realized that large exposed glass areas, typical of school buildings, created a need for Honeywell Customized Temperature Control in the Charles B. Glenn Vocational High School. Other participating firms were: General Contractor, Richardson Construction Company; Mechanical Contractor, H. L. Eskew & Sons. All firms are located in Birmingham.

New high school demonstrates need for Honeywell Customized Temperature Control even in mild climate of the South

Birmingham's Charles B. Glenn

Vocational High School features individual room temperature control

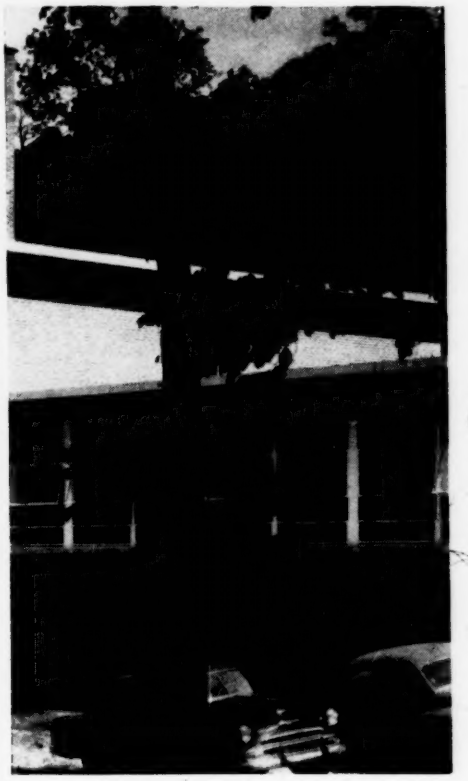
In developing the new school you see here, an enterprising architectural-engineering firm and an understanding school board are leading the way to greater comfort and more efficient learning for thousands of southern teen-agers.

And a Honeywell Customized Temperature Control installation is helping them provide these benefits for Birmingham students.

In the case of the Glenn School, the Honeywell installation is in the form of individual room temperature control—a thermostat in each classroom. The floor plan at right gives the location of the thermostats.

Today, in this school, teachers may keep temperatures right for most efficient learning—simply by adjusting a dial.

If the wind blows cold against the windows of their individual classroom they can easily adjust for the extra heat loss. And if during certain periods of the day the room is crowded, or the sun is hot, they can as easily *lower* the temperature.



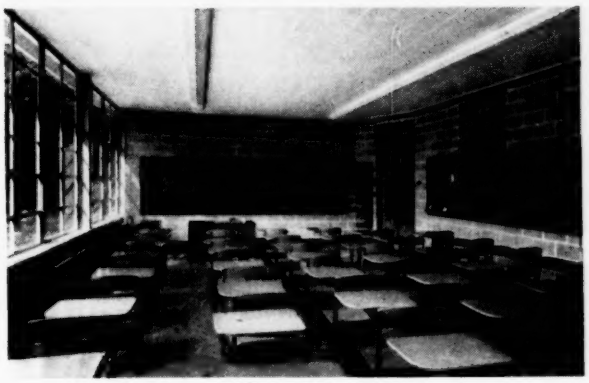
For Comfortable, Even Temperature in New or Existing Buildings—of any size—Specify Honeywell Customized Temperature Control

Whether it's a school, office, factory, hospital, apartment, store, garage—or any size building—new or existing, Honeywell Customized Temperature Control can help meet your clients' heating, ventilating, air conditioning and industrial control problems.

Once equipped with Honeywell Customized Temperature Control, they'll have an ideal indoor "climate"—and save fuel besides.

And with a complete line of pneumatic, electric and electronic controls to choose from, Honeywell Customized Temperature Control offers you the greatest flexibility in design. Then, too, when it comes to performance, Honeywell-built controls assure years of trouble-free operation. And they're backed by the finest service organization in the controls industry.

For full facts on Honeywell Customized Temperature Control, call your local Honeywell office. There are 104 across the nation. Or mail the coupon today.



In winter months, even in the South, classroom windows are a major source of heat loss. Chill winds reduce their temperature greatly—and this "draws" heat in large quantities. But with an adjustable Honeywell thermostat in each classroom such heat loss is easily compensated for. Above you see a typical modern classroom in the Charles B. Glenn school.

H. L. Eskew, heating contractor of Birmingham, says: "More and more in the South we're coming to realize the importance of proper temperature control and adequate heating methods. I think the Charles B. Glenn High School job is good evidence of that."

MINNEAPOLIS **Honeywell**

H HONEYWELL *First in Controls*

MINNEAPOLIS-HONEYWELL REGULATOR CO.
Dept. HV-1-14, Minneapolis 8, Minnesota

Gentlemen:
Please send me a free copy of the heating plans used for the Charles B. Glenn School, and more information about Honeywell Customized Temperature Control.

Name .....

Firm Name .....

Address .....

City ..... *Zone* ..... *State* .....

You check every part of an Alco Solenoid Valve in about two minutes. They can be completely dismantled without removal from the line. Remove coil and housing, open two cap screws and the valve is ready for examination and cleaning.

SIMPLE, ISN'T IT? And Alco Solenoids are packless, tight-seating, quiet. They're completely moisture-proof to eliminate coil burn-out. Alco Solenoids assure *easier servicing* for you and *longer service* for your customers.

SEE YOUR ALCO WHOLESALER

ALCO VALVE CO.

859 KINGSLAND AVE. • ST. LOUIS 5, MO.

Designers and Manufacturers of Thermostatic Expansion Valves; Evaporator Pressure Regulators; Solenoid Valves; Float Valves; Float Switches.

Men who know ducts INSIDE..

ULTRALITE DUCT LINER—ACOUSTICAL

This is the duct liner that **won't burn!**—a flexible, resilient, semi-rigid glass fiber insulation designed specifically as acoustical duct liner. Has excellent sound absorbing properties, particularly at the irritating noise levels. Won't break, flake or chip. Runs quickly around curves and corners. Friction loss is low. Won't delaminate under air movement; won't flake off in air stream.

ULTRALITE DUCT INSULATION and DUCT LINER

have every characteristic that makes application easy and quick. They're light, flexible, resilient; you can cut them with a knife; run them quickly around curves and corners; adhere them to metal with adhesives . . . screws and washers . . . wires! Get full details on Ultralite and learn why it goes on faster, easier and cheaper than any insulation you've ever used!

..and OUT..

ULTRALITE DUCT INSULATION — THERMAL

A soft, resilient, flexible insulation of long, fine glass fibers with a low K-factor. Available plain or with your choice of 4 vapor barrier facings, already adhered to the insulation. Wrap-around method of application cuts applied costs way down. Non-irritating, pleasant to handle. Fire-resistant, non-corrosive to metals.

...use ULTRALITE throughout!

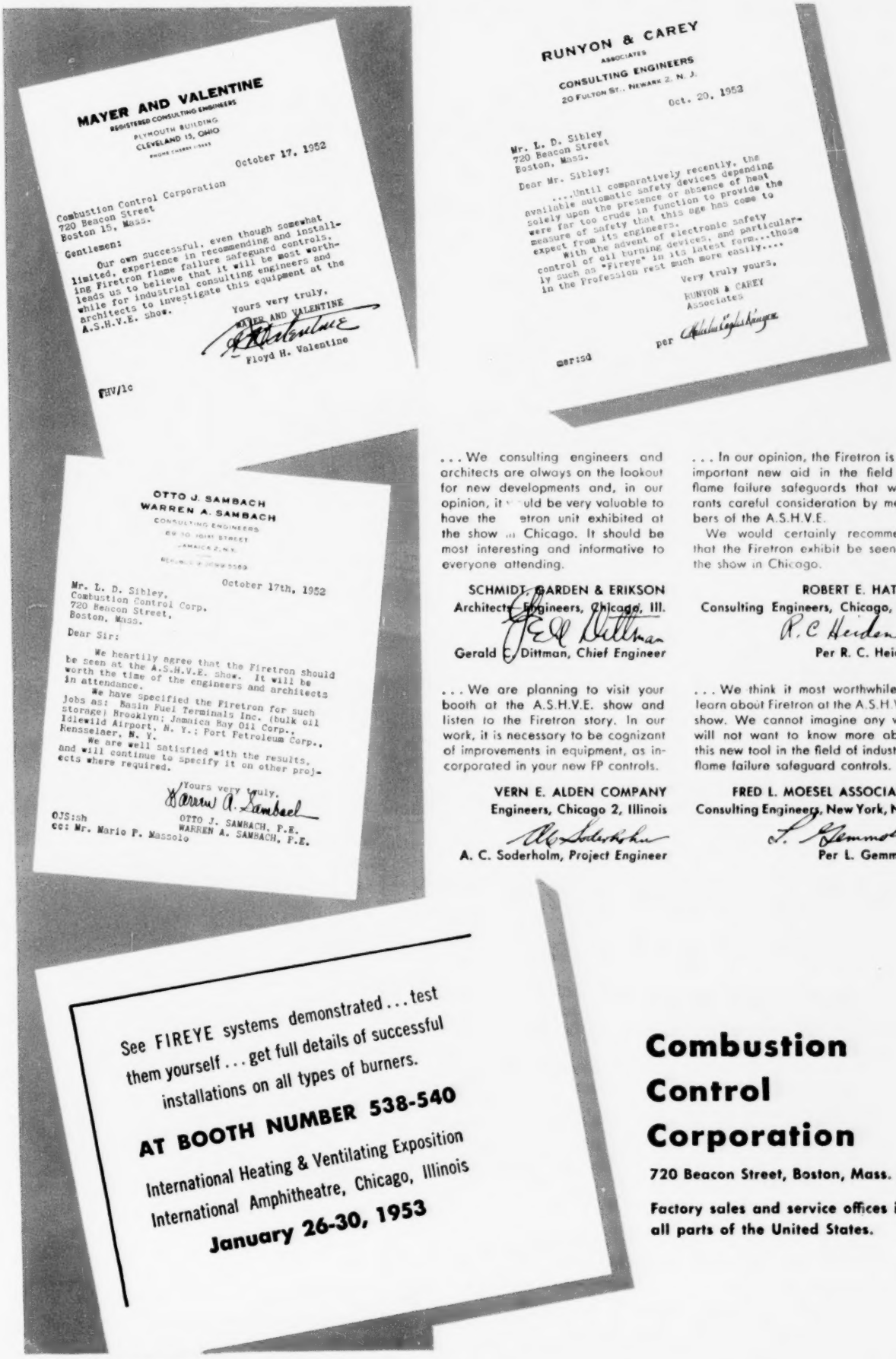
Visit our Booth (No. 543) at the A. S. H. & V. E. Show in Chicago, January 26-30, or call your local Ultralite Distributor (listed in the Yellow Pages).

GUSTIN-BACON MANUFACTURING CO.

210 W. 10th St., Kansas City, Mo.

New York • Chicago • Philadelphia • San Francisco • Los Angeles • Houston
Tulsa • Ft. Worth • Detroit • St. Louis

NOW
universal
acceptance
Safe, fully automatic
operation of
commercial and
industrial gas and
oil burners with
firetron
The Fireye that sees all flames
fireye
FIREYE flame-failure safe-
guards and programming
controls for automatic and
manually fired burners.



MAYER AND VALENTINE
REGISTERED CONSULTING ENGINEERS
PLYMOUTH BUILDING
CLEVELAND 15, OHIO

October 17, 1952

Combustion Control Corporation
720 Beacon Street
Boston 15, Mass.

Gentlemen:

Our own successful, even though somewhat limited, experience in recommending and installing Firetron flame failure safeguard controls, leads us to believe that it will be most worthwhile for industrial consulting engineers and architects to investigate this equipment at the A.S.H.V.E. show.

Yours very truly,
MAYER AND VALENTINE
Floyd H. Valentine

FHV/lc

RUNYON & CAREY
ASSOCIATES
CONSULTING ENGINEERS
20 FULTON ST., NEWARK 2, N. J.

Oct. 20, 1952

Mr. L. D. Sibley
720 Beacon Street
Boston, Mass.

Dear Mr. Sibley:

....Until comparatively recently, the available automatic safety devices depending solely upon the presence or absence of heat were far too crude in function to provide the measure of safety that this age has come to expect from its engineers.
With the advent of electronic safety control of oil burning devices, and particularly such as "Fireye" in its latest form...those in the Profession rest much more easily....

Very truly yours,
RUNYON & CAREY
Associates
per

mer:sd

OTTO J. SAMBACH
WARREN A. SAMBACH
CONSULTING ENGINEERS
89-30 161st STREET
JAMAICA 2, N.Y.

October 17th, 1952

Mr. L. D. Sibley,
Combustion Control Corp.
720 Beacon Street,
Boston, Mass.

Dear Sir:

We heartily agree that the Firetron should be seen at the A.S.H.V.E. show. It will be worth the time of the engineers and architects in attendance.
We have specified the Firetron for such jobs as: Basin Fuel Terminals Inc. (bulk oil storage) Brooklyn; Jamaica Bay Oil Corp., Idlewild Airport, N. Y.; Port Petroleum Corp., Rensselaer, N. Y.
We are well satisfied with the results, and will continue to specify it on other projects where required.

Yours very truly,
OTTO J. SAMBACH, P.E.
WARREN A. SAMBACH, P.E.

OJS:sh
cc: Mr. Mario P. Massolo

. . . We consulting engineers and architects are always on the lookout for new developments and, in our opinion, it would be very valuable to have the Firetron unit exhibited at the show in Chicago. It should be most interesting and informative to everyone attending.

SCHMIDT, GARDEN & ERIKSON
Architects-Engineers, Chicago, Ill.
Gerald C. Dittman, *Chief Engineer*

. . . We are planning to visit your booth at the A.S.H.V.E. show and listen to the Firetron story. In our work, it is necessary to be cognizant of improvements in equipment, as incorporated in your new FP controls.

VERN E. ALDEN COMPANY
Engineers, Chicago 2, Illinois
A. C. Soderholm, *Project Engineer*

. . . In our opinion, the Firetron is an important new aid in the field of flame failure safeguards that warrants careful consideration by members of the A.S.H.V.E.

We would certainly recommend that the Firetron exhibit be seen at the show in Chicago.

ROBERT E. HATTIS
Consulting Engineers, Chicago, Ill.
Per R. C. Heiden

. . . We think it most worthwhile to learn about Firetron at the A.S.H.V.E. show. We cannot imagine any who will not want to know more about this new tool in the field of industrial flame failure safeguard controls.

FRED L. MOESEL ASSOCIATES
Consulting Engineers, New York, N.Y.
Per L. Gemmola

See FIREYE systems demonstrated . . . test them yourself . . . get full details of successful installations on all types of burners.

AT BOOTH NUMBER 538-540

International Heating & Ventilating Exposition
International Amphitheatre, Chicago, Illinois
January 26-30, 1953

Combustion Control Corporation

720 Beacon Street, Boston, Mass.

Factory sales and service offices in all parts of the United States.

Bush Baseboard Radiation

for steam or hot water systems . . .

Bush Baseboard Radiation offers the heating contractor a modern heating unit tailored to meet the most exacting requirements of Architects, Engineers and Homeowners.

Designed specifically to prevent "wall-streaking", Bush Baseboard Radiation provides a form of perimeter heating which results in uniform heat . . . warm floors. *Ideal* for modernization of old, inefficient heating systems or for new installations. Available in two styles and materials to meet varying demands of output and size.

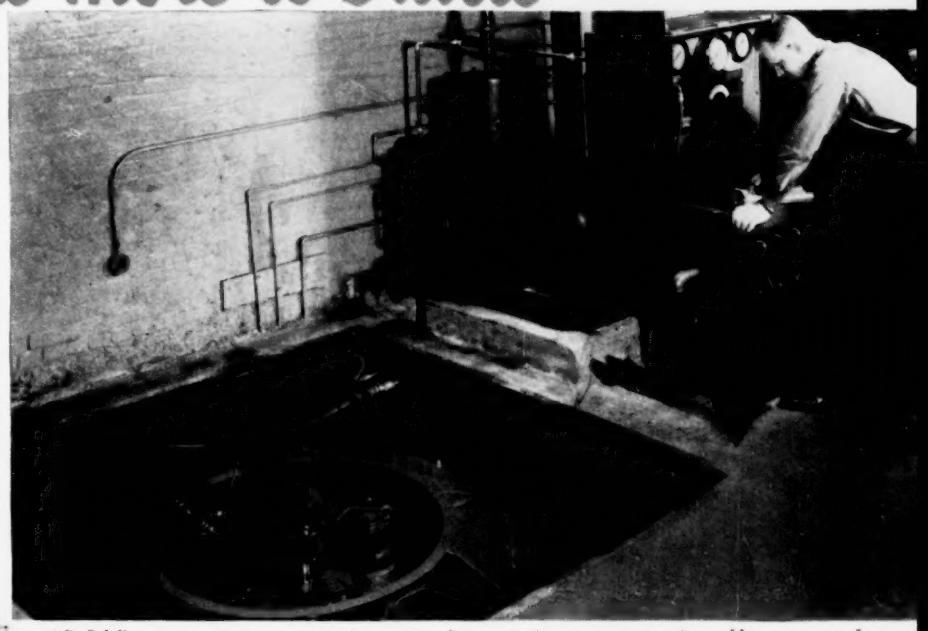
Bulletin 565, free upon request, contains complete data.

Bush Manufacturing Company

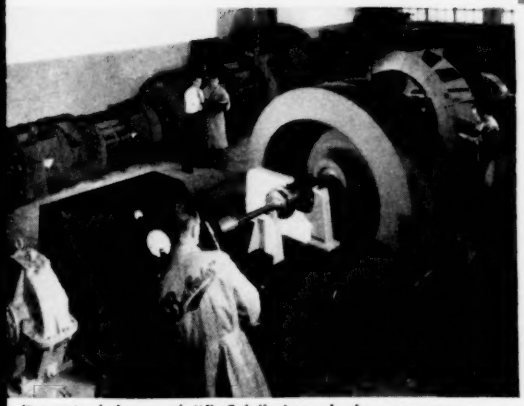
WEST HARTFORD 10, CONNECTICUT

Why it costs more to build

"Buffalo" FANS



"Buffalo" vacuum pit for test-spinning rotors. Extremely low vacuum in pit enables rotors to be spun at high speeds to ultimate destruction.



Dynamic balance of "Buffalo" fan wheels guarantees smooth, quiet operation.

Accurate testing assures rated performance of "Buffalo" Fans.

As many readers of this advertisement know, "Buffalo" was the first manufacturer of air moving equipment to treat air engineering as a serious scientific subject, worthy of continuous study. With the publication, in 1914, of "Fan Engineering", now in its Fifth Edition, Buffalo Forge Company paved the way for the tremendous expansion in all forms of air handling, conditioning and cleaning, which we now accept as common-place.

We have never deviated, for one year from the ideals which led to "Fan Engineering" in 1914. We are still interested basically in the "Q" Factors*. This means the building of the best possible product.

This policy has cost us some business in the past, and no doubt will in the future. It has, however, earned us a reputation for fine performance over long periods of years, and has enabled our company to sell many of the finest and most outstanding installations in industry and commerce.

When you buy Buffalo Fans, Air Cleaning or Conditioning Equipment, you can be sure that you are getting the best that seventy-five years of experience can produce.

Engineering Sales Representatives in all principal cities are anxious to work with you.

* The "Q" Factor — The built-in Quality which provides trouble-free satisfaction and long life.

DIAMOND JUBILEE 75TH ANNIVERSARY

"Buffalo" FIRST FOR FANS

BUFFALO FORGE COMPANY

480 BROADWAY BUFFALO, NEW YORK

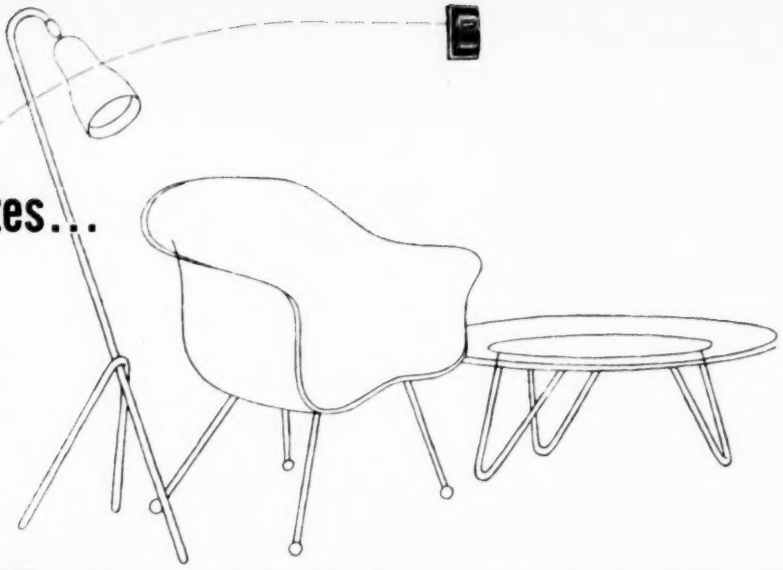
PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

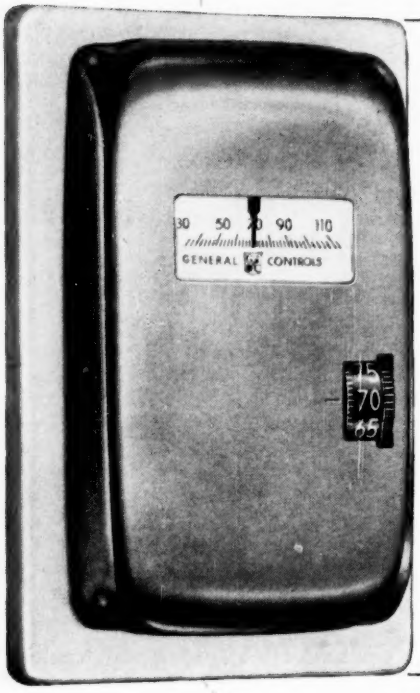
Canadian Blower & Forge Co., Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING
FORCED DRAFT COOLING HEATING PRESSURE BLOWING

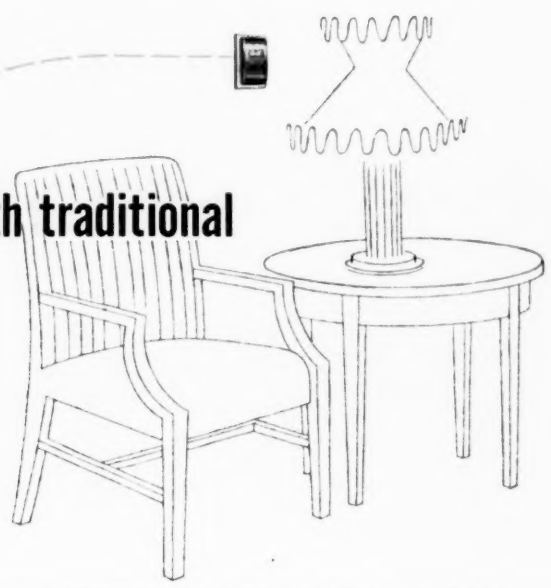
Beauty that harmonizes...

with modern





with traditional



with provincial

General Controls Metrotherm "belongs" in any room, with its flush-design, all metal case in rich, ever-lasting satin-chrome finish, harmonizing with any interior decorative theme. Because of this durable all-metal case, there is no fragile painted surface to chip, crack, show finger marks or smudge. Because it is sensitive to both radiant and convected heat, it holds accurate temperature level at all times.

New for '53

- *easy-to-read temperature dial has permanent white numerals imbedded in plastic*
- *new clear-vision thermometer*

Best for you...

and your customer, too

General Controls

B-60

Self-Generating Heat Control System

With the addition of the new *700 millivolt pilot generator*, this completely self-powered control system now fits the greatest range of heat control applications. Since the origination of the B-60 self-generating package sets by General Controls 14 years ago, hundreds of thousands of these controls have given trouble-free performance. No outside current required. No power-failure service calls. Quiet operation, accurate temperature control, positive safety. A variety of standard and timer thermostats available.

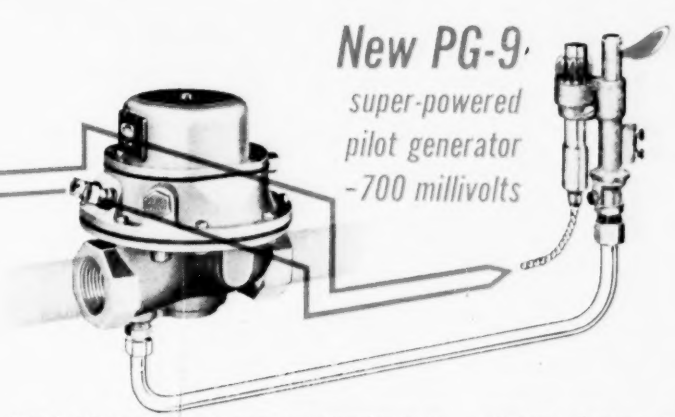
General Controls

GLENDALE 1, CALIFORNIA • SKOKIE, ILLINOIS

Manufacturers of Automatic Pressure, Temperature, Level and Flow Controls for Heating, Home Appliances, Refrigeration, Industrial and Aircraft Applications.

FACTORY BRANCHES IN 32 PRINCIPAL CITIES —
SEE YOUR CLASSIFIED TELEPHONE DIRECTORY

A variety of General Controls Thermostats helps you satisfy every customer—T-70 with permanent magnet and snap-action contacts—T-99 with mercury switch. T-70X and T-70T have built-in interval Swiss timers permitting shut-off of daytime temperatures for any selected period up to 13½ hours and night setting for minimum temperatures. T-70 and T-99 Thermostats also available for 24-volt circuits.



The B-60 Gas Valve is operated electrically by the current supplied from the pilot generator. It opens and closes gas fuel line at the demand of a room thermostat or limit control. Valve closes if pilot is extinguished, providing positive safety control. The B-60 Valves are standard for all gases. Available in all standard pipe sizes from ⅜" to 1½".

General Controls PG-9 Pilot Generators perform three jobs—(1) main burner ignition, (2) pilot safety, and (3) millivolt generation to operate the control system. Maximum millivolt generation (700 mv) obtained with low pilot gas consumption.

Whose cheese is being divided?

TWO cats could not agree on fair division of a tasty cheese. "Let's go to the monkey," said one, "He is all-wise and can divide our cheese fairly." So to the monkey they went.

The monkey immediately broke the cheese evenly and judicially put the two pieces on the pans of his balance. But one was slightly heavier. He shrewdly nibbled that piece a bit and put it back on the scales. Now it was the lighter piece. So he bit off some of the other piece only to find it the lighter. Thus while the two hungry cats watched, the monkey kept taking bites of the cheese, first one piece, then the other, until finally the cheese had almost disappeared.

"What's left is too small to divide," sagely pronounced the monkey, as he popped the remaining fragments into his mouth.

Observers of the American scene see a direct parallel between the record of federal taxation and this ancient parable of the trusting cats, the greedy monkey and the cheese. Business and the individual citizen have been content to trust government to rule on the disposition of their earnings. And Uncle Sam keeps taking bite after bite out of the shares of both individual citizen and business.

Already government bites are so large as to severely penalize citizens and business alike. If allowed to continue, it will seriously impede further industrial progress and growth, stifle initiative and threaten the strength of our free enterprise system. Beware the day—goal of the socialists among us—when the monkey says, "What's left is too small to divide."

QUALITY V YOUNGSTOWN SERVICE

The Youngstown Sheet and Tube Company

General Offices--Youngstown 1, Ohio

Export Offices--500 Fifth Avenue, New York

MANUFACTURERS OF CARBON ALLOY AND YOLOY STEELS

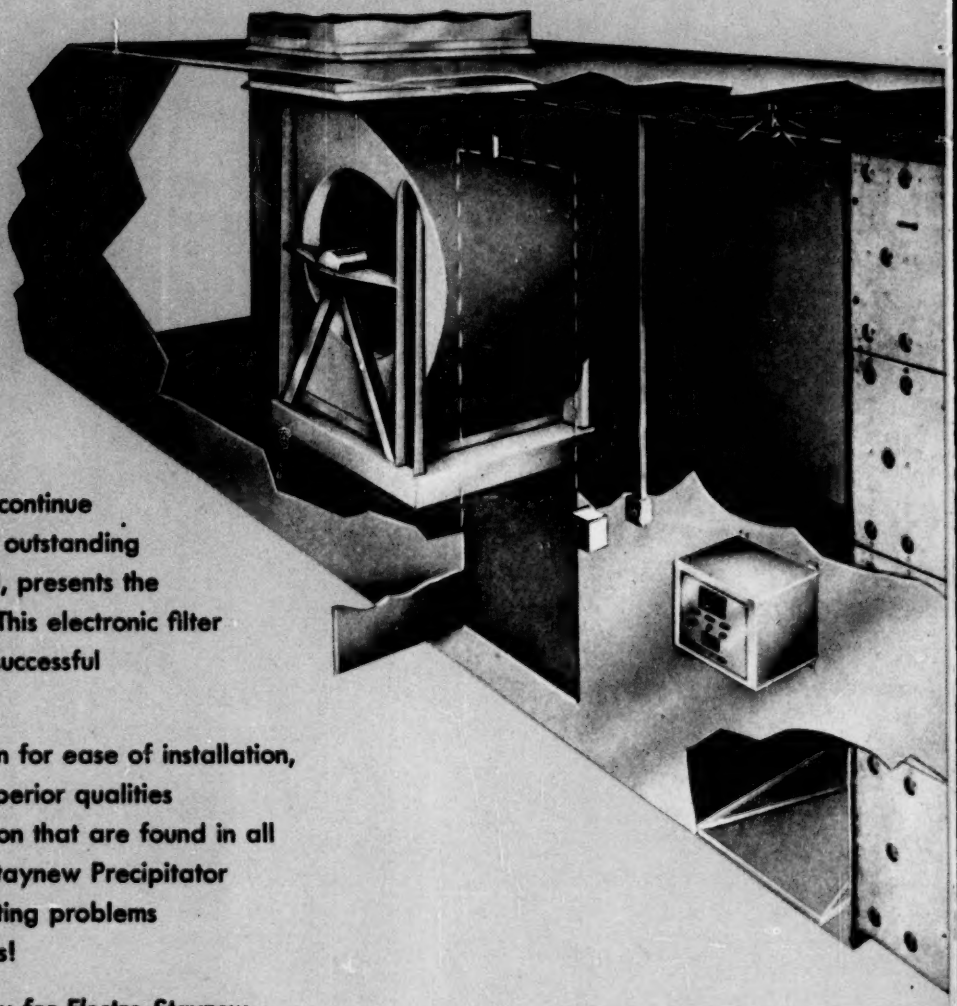
RAILROAD TRACK SPIKES - CONDUIT - HOT AND COLD FINISHED CARBON AND ALLOY BARS - PIPE AND TUBULAR PRODUCTS - WIRE - ELECTROLYTIC TIN PLATE - COKE TIN PLATE - RODS - SHEETS - PLATES.

ANNOUNCING
THE DOLLINGER
Electro-STAYNEW
PRECIPITATOR

Engineered and Manufactured by

DOLLINGER CORPORATION, Rochester 3, New York

NOW! WE'VE ADDED THIS NEW COMPLETE LINE OF STAYNEW

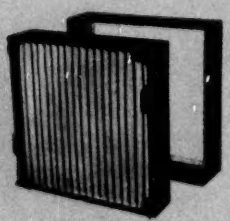


The Dollinger Corporation, to continue its policy of manufacturing an outstanding filter for every industrial need, presents the Electro-Staynew Precipitator. This electronic filter is a completely tried, tested, successful unit . . . *not* a new invention.

It features *one-unit* construction for ease of installation, and incorporates the same superior qualities necessary for precision filtration that are found in all Staynew Filters. The Electro-Staynew Precipitator is the answer to many ventilating problems . . . perhaps it can solve yours!

For complete details write today for Electro-Staynew Bulletin 400, or contact your Dollinger Representative.

Model D
Intake Filter



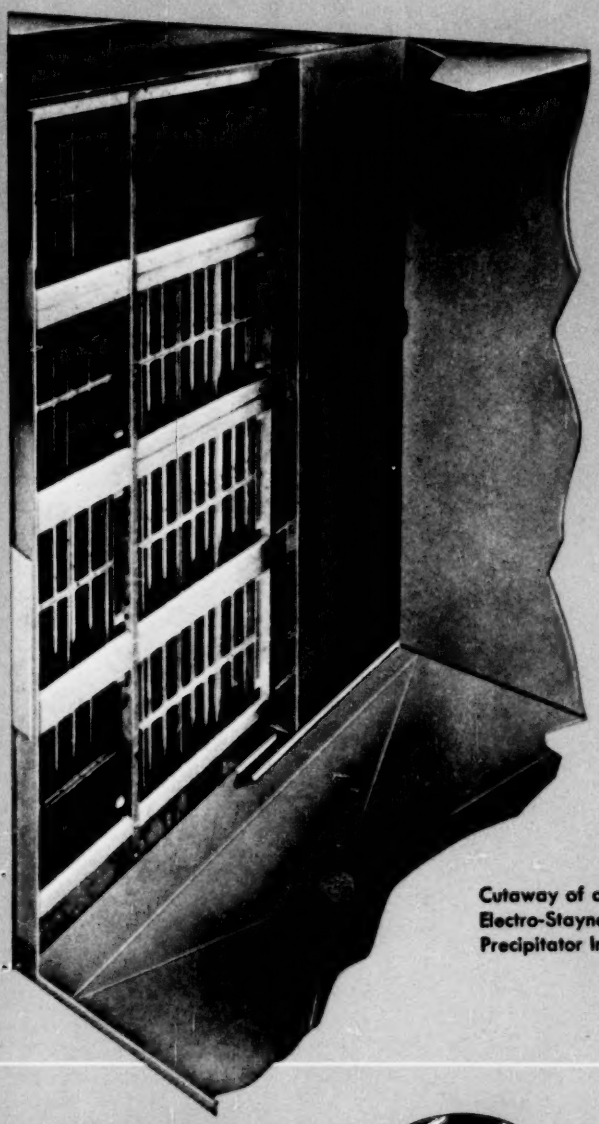
Model WKE
Dry Panel Filter

Automatic Self
Cleaning Type Filter

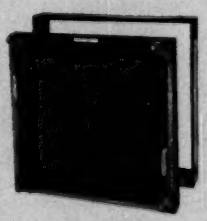
Model CPH
Pipeline Filter

Model HE
Hydraulic Filter

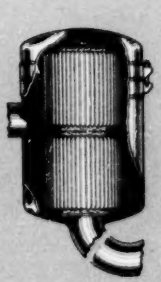
PRECIPITATOR TO THE FILTERS!



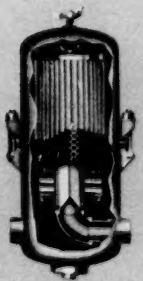
Cutaway of a typical Electro-Staynew Precipitator Installation.



Model DPV
Viscous Panel Filter



Model CPHG
Gas Filter



Model ELS
Liquid Filter

TYPICAL INDUSTRIAL PRECIPITATOR APPLICATIONS

APPLICATION	ADVANTAGES
Art Galleries Libraries Radio Studios	Dust deterioration eliminated—valuable books, paintings, records and files protected.
Banks Offices Public Buildings	Cleaner, more healthy working conditions possible. Painting, cleaning and redecorating costs reduced.
Breweries	Close control of yeast germination realized. Foreign spores and bacteria-carrying particles eliminated, permitting a finished product without spoilage.
Chemical Plants	Highly refined chemical processes completed without contamination.
Department Stores	Merchandise remains clean and attractive. Time previously consumed by employees in dusting stock can be spent more profitably on sales. Greater profits obtainable as merchandise remains salable longer.
Food and Meat Processing	Food can be prepared and packaged without dust contamination.
Food Stores	Sanitary conditions assured. Nuisance dusts eliminated. Stocks and displays attractive and clean.
Restaurants Night Clubs Theatres Hotels	Greater patronage with offensive smoke haze eliminated. Sustained redecorating costs greatly decreased. Decorations, furnishings and walls remain clean and bright.
Schools Colleges Churches Auditoriums	Rids the atmosphere of smokes and air-borne bacteria-laden dust, thereby lessening the hazard of common contagious illnesses.
Steel Mills Aluminum Mills Other Metal Processing Mills	Necessary Ventilating Air provided for machinery and electrical apparatus. Clean air for rotating machines and to blast furnaces.
Drug and Pharmaceutical Manufacturing	Pure products assured with a germ-free atmosphere.
Hospitals Clinics Laboratories	Clean pure ventilation of operating rooms, sick rooms, and wards assured. Relief for patients susceptible to air-borne pollens and dusts.
Plants Manufacturing: Automobiles, Aircraft, Engines, Optical Goods, Photographic Film, Plastics, Electronic Products, Precision Instruments, etc.	Elimination of abrasive dusts dangerous to both worker and product. Monetary gains permitted with fewer rejects. Precision surfaces finished without impairment from dust particles. Improved painting operations. Greater operating efficiency.
Photo and Movie Studios	Film, developing solutions, cameras and other expensive equipment protected from harmful dirt and dust.
Power Plants, Substations, Telephone Exchanges, Radio Transmitting Stations	Relays and switch gear equipment permitted to operate without costly interruption. Necessary ventilating air provided for vital electrical machinery.
Testing Laboratories	Precision equipment protected. Exacting tests can be performed in a clean atmosphere.
Textile Mills	Each manufacturing stage protected, thereby permitting a high quality finished fabric. Eliminate costly rejects and waste due to soilage.

BRING YOUR FILTRATION PROBLEMS TO EXPERIENCED DOLLINGER ENGINEERS

The Dollinger Corporation serves all industry with filters for any specific requirement. You can choose from our complete line of mechanical filters for air, liquids and gases. We can supply the Electro-Staynew Precipitator for removal of 90%* or more of all air-borne dirt in industrial and commercial air conditioning systems. And . . . this outstanding Staynew Filter Line is backed by complete engineering, design and laboratory facilities for developing special filters for any application. This service is available upon request without cost or obligation.

*BUREAU OF STANDARDS Discoloration Test Method

NATION WIDE SERVICE ORGANIZATION

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Atlanta, Georgia
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Dallas, Texas
Denver, Colorado
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Fort Wayne, Indiana
Fort Worth, Texas
Greenville, S. C.
Hartford, Connecticut
Houston, Texas
Indianapolis, Indiana
Iron Mountain, Michigan
Kansas City, Missouri
Little Rock, Arkansas
Los Angeles, California
Marshalltown, Iowa
Memphis, Tennessee
Miami, Florida
Milwaukee, Wisconsin
Minneapolis, Minnesota
Mobile, Alabama
Nashville, Tennessee
New Brunswick, New Jersey
New Orleans, Louisiana
New York, New York
Norfolk, Virginia
Philadelphia, Pennsylvania
Phoenix, Arizona
Pittsburgh, Pennsylvania
Portland, Oregon
Providence, Rhode Island
Richmond, Virginia
Rochester, New York
St. Louis, Missouri
Salt Lake City, Utah
San Francisco, California
Seattle, Washington
Springfield, Massachusetts
Syracuse, New York
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Tulsa, Oklahoma
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Wichita, Kansas
Worcester, Massachusetts
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Mexico City, Mexico
Montreal, Quebec, Canada
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Toronto, Ontario, Canada
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DOLLINGER PROTECTOMETER STAYNEW FILTERS

DOLLINGER CORPORATION

56 Centre Pk., Rochester 3, N. Y.

ALL TYPES OF FILTERS FOR EVERY INDUSTRIAL NEED

...ise in U. S. A.

● Now you can get famous Kno-Draft efficiency in a *square* diffuser — complete with built-in volume control, circular air patterns, and the sturdy construction that characterizes all Kno-Draft Air Diffusers.

The picture shows the Kno-Draft *Square* Diffuser, Type KPT, designed for T-bar installations. It snaps easily and snugly into perforated acoustical-type ceilings. For overlapping installation, Type KP is the unit to use.

Heating and air conditioning men who have installed the new Kno-Draft *Square* Diffusers will tell you these handsome units do an outstanding job. Naturally. They're made by men who have been "engineering air" for more than twenty years.

Quickest way to get full engineering information on Kno-Draft *Square* Diffusers is to clip the coupon and mail it to W. B. Connor Engineering Corporation, Danbury, Connecticut.

CONNOR ENGINEERING CORPORATION

kno·draft ®

adjustable air diffusers

CONNOR ENGINEERING CORP.
Dept. J-13, Danbury Connecticut

Please RUSH full information on the new Kno-Draft *Square* Diffusers.

Name .....

Position .....

Company .....

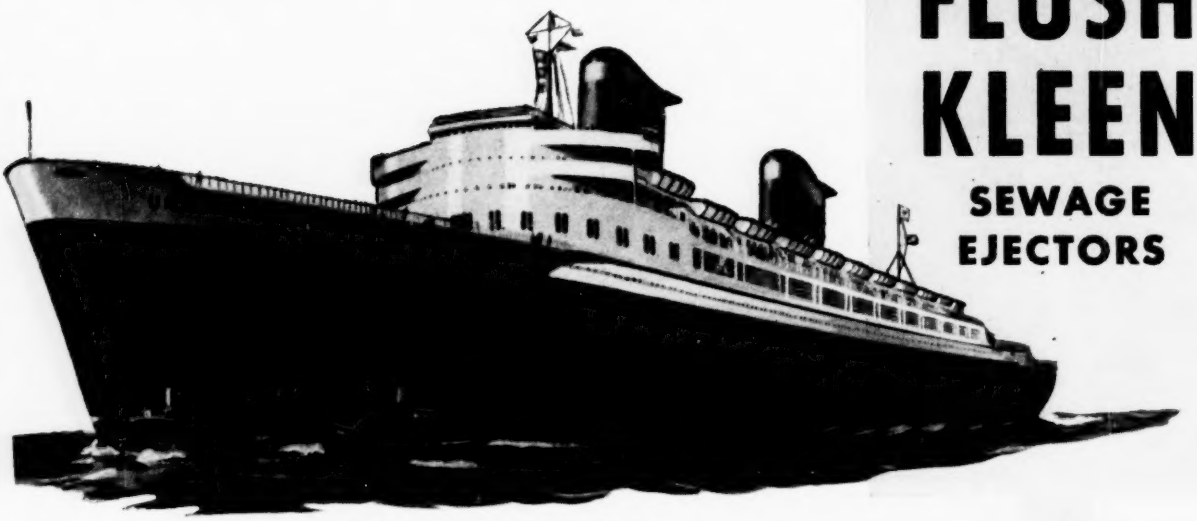
Street .....

City ..... Zone ..... State .....

THE GREAT NEW AMERICAN FLAG SUPERLINER

S. S. UNITED STATES

IS EQUIPPED WITH FLUSH KLEEN SEWAGE EJECTORS



Built for United States Lines by the Newport News Shipbuilding and Drydock Company, Gibbs & Cox, Naval Architects under auspices of the UnitedStates Maritime Administration.

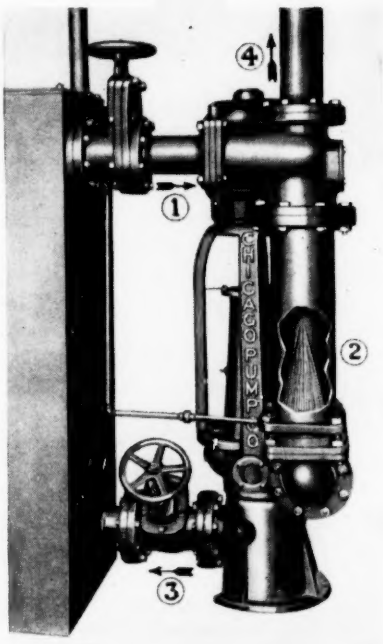
The new S.S. United States, the largest, fastest and safest superliner ever built in this country, is equipped with many duplex sets of FLUSH-KLEEN EJECTORS (more than enough sewage pumping capacity to meet the need of a good-sized town).

FLUSH-KLEEN EJECTORS were selected on a proven record of ship performance . . . since 1936 they have been giving *trouble-free service, clog-proof operation* and *low-cost maintenance* on numerous troop transports, cargo ships, hospital ships, as well as on the "America", now our country's second largest passenger ship.

The selection of FLUSH-KLEEN EJECTORS for the new "United States" reflects the acceptance that these units have gained from engineers who design pumping stations for commercial or industrial plumbing systems, and municipal lift stations—*as more than 5,000 Duplex Flush Kleen Ejectors are now in operation in plants the country over.*

If you do not have all the facts about FLUSH-KLEEN EJECTORS, please request Bulletin No. 122—it will be sent to you promptly.

CHICAGO INDUSTRIAL PUMPS



The positive clog-proof operation of FLUSH-KLEEN EJECTORS is readily understood by referring to the cut-away illustration.

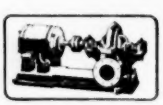
FILLING WET WELL—(1) Sewage flows through inlet pipe. (2) Sewage solids are retained by strainer. (3) Strained sewage flows through idle pump to basin.

PUMPING—(3) Strained sewage is pumped from basin. (2) Sewage solids are backwashed from strainer. (4) Special check valve closes; sewage and solids are pumped overboard.

CHICAGO PUMP COMPANY

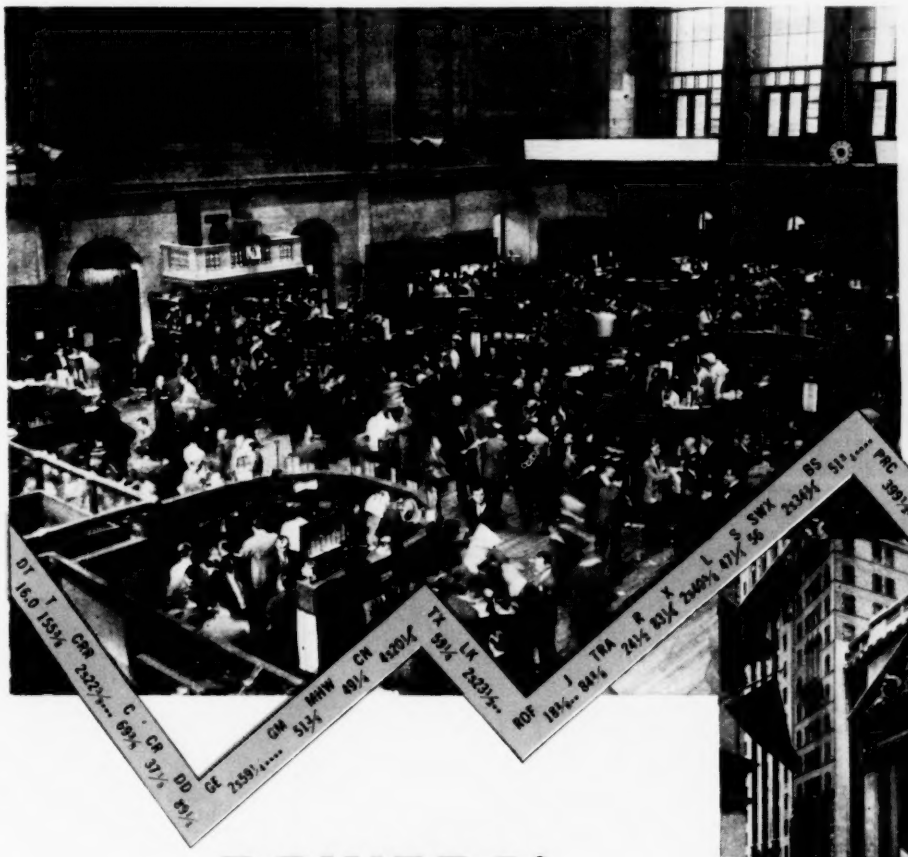
BUILDING and INDUSTRIAL DIVISION

622 DIVERSEY PARKWAY — **CHICAGO 14, ILLINOIS**



Condo-Vac, Sure Return, AVC, LVC, Fire, House & Circulating Pumps
Pneumatic & Tankless Water Systems

Flush-Kleen Sewage Ejectors
Little Giant & Non-Clog Bilge Pumps
Pumps for every industrial use.



NEW YORK STOCK EXCHANGE

The Nation's Largest Securities Market Place

BULLS and BEARS all agree on the value of air conditioned comfort

Consulting Engineer present air conditioning system: Charles S. Leopold

POWERS®

AIR CONDITIONING CONTROL

Used in this World Famous Securities Market

No matter how the "temperature" of the market fluctuates, air conditions on the trading floor of the Stock Exchange remain stable throughout the year.

Back in 1903 the New York Stock Exchange pioneered with the installation of a comfort cooling system which Mr. Donald A. Kepler, Chief Engineer describes as follows:

"It was one of the first systems of its kind applied to a large densely populated market place and by far the largest plant devoted primarily to air cooling and dehumidification. No controls were employed in the cooling season but in winter temperature and humidity were automatically controlled by a pneumatic system.

The air conditioning system now in use, the third since 1903, is modern and reflects the progress of air conditioning during the past 50 years."

Other Prominent Users of Powers Control

TORONTO STOCK EXCHANGE • MIDWEST STOCK EXCHANGE

When temperature and humidity control problems arise contact Powers nearest office. Our 60 years of experience gained in many important buildings may be helpful to you.

Factory and General Offices: Skokie, Ill.

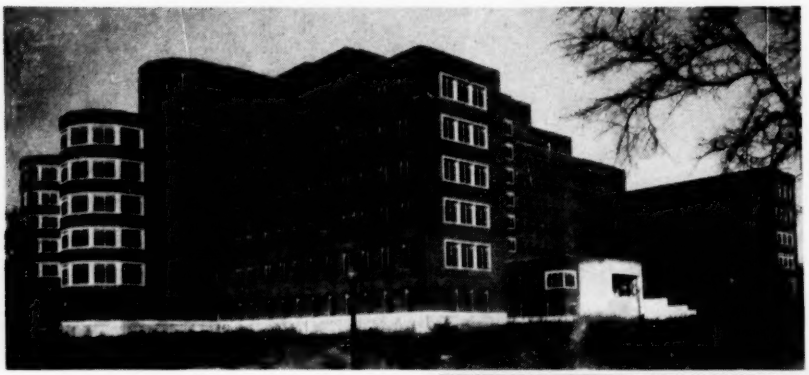
Mr. D. A. Kepler, Chief Engineer, in the photograph above, reports temperature is held within limits of approximately 1° F. plus or minus.

POWERS CONTROL

(a94)

OFFICES IN OVER 50 CITIES **THE POWERS REGULATOR COMPANY** Established 1891

ENGINEERED for Quiet Operation

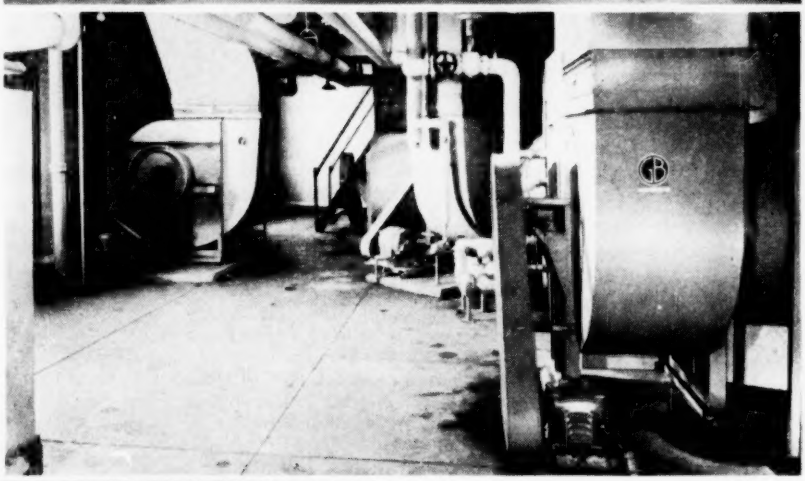


GENERAL BLOWER has developed a rugged line of blowers with minimum impeller noise. Quiet operation is essential in hospitals and institutions. These blowers have been time-tested, and operate efficiently under the most severe conditions. Aside from the installations shown, GENERAL BLOWERS were recently installed in East Harlem and Cumberland Hospitals, in New York City, and in Utica State Hospital, Utica, New York.

Hudson River State Hospital and equipment room, Dept. of Public Works.

Whitney-Dierks Heating Corp., Heating and Ventilating Contractors.

HOSPITAL QUIET



Meadowbrook Hospital and equipment room.

Eggers & Higgins, Architects and Engineers.

Guy Panero, Consulting Engineer.

Arthur E. Magher Corp., Heating and Ventilating Contractors.

GENERAL BLOWER COMPANY

MORTON GROVE, ILL.

Twenty-five years' background in the fan and blower industry. Engineering offices in major cities.

Taking the Stains and Strains out of DUPLICATING

Duplicating letters was a messy, tedious job in the '90's. If a girl was extremely efficient, she could turn out *five* copies per minute.

How different today—motor driven machines, featuring automatic inking and feeding, make *180 copies per minute* with ease!

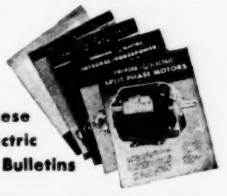
Dramatic progress, such as this, has followed the motorizing of equipment used in business, in industry, in the home, and on the farm, too.

Throughout our 63-year history Emerson-Electric has been called upon by many of the nation's leading manufacturers to design and produce dependable, efficient motors for their applications.

Get detailed information on how Emerson-Electric motors, in ratings from 1/20 h.p. to 5 h.p., can add new sales appeal to your product.

Write...THE EMERSON ELECTRIC MFG. CO., St. Louis 21, Mo.

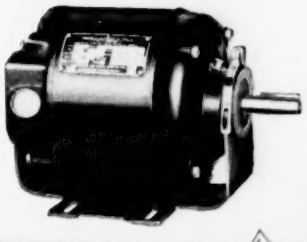
MODERN BUSINESS IS POWERED WITH ELECTRIC MOTORS

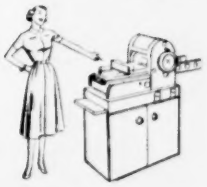


Write for these Emerson-Electric Motor Data Bulletins

Manufacturers requiring motors 1/20 to 5 h.p. can profitably use these reference guides. Specifications, construction and performance data are included for these motors:

- ☐ M167-A Capacitor-Start
- ☐ M167-B Split-Phase
- ☐ M167-C Integral
- ☐ M167-D Fan-Duty
- ☐ M167-E Oil-Burner
- ☐ M167-F Jet Pump
- ☐ M167-G Blower

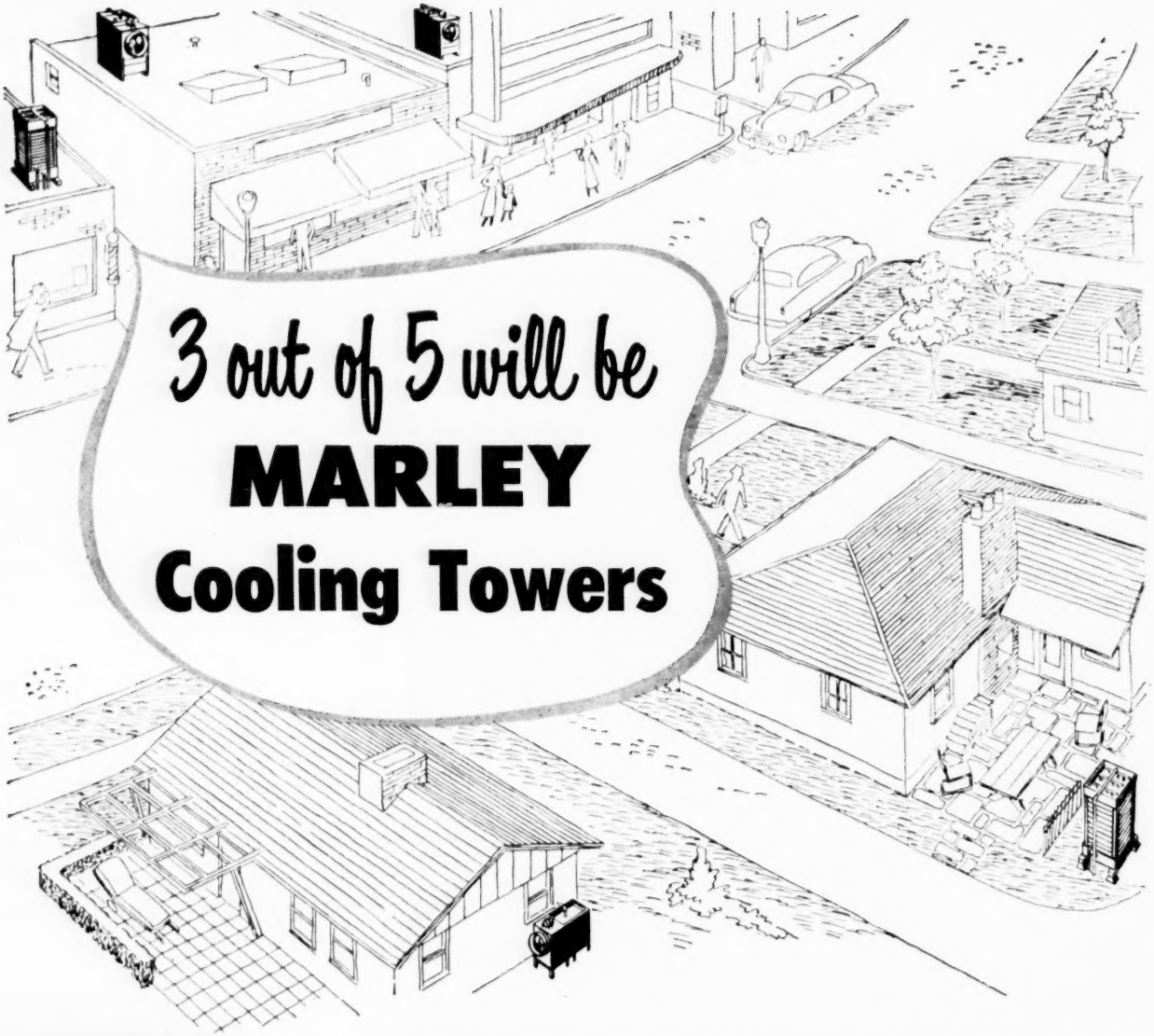




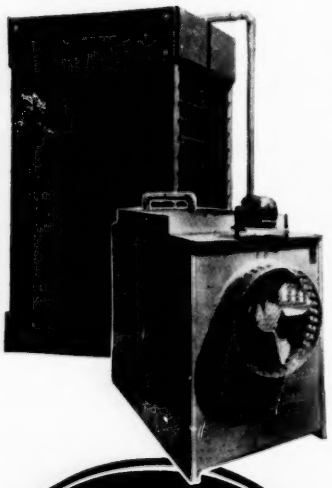
A. B. Dick Co., builder of modern Mimeographing equipment is a user of Emerson-Electric motors.

EMERSON ELECTRIC
MOTORS • FANS APPLIANCES

LEADERS IN THE MOTOR AND FAN INDUSTRY SINCE 1890



3 out of 5 will be MARLEY Cooling Towers



Every reliable estimate points to an unprecedented market in 1953 for air conditioning — and a corresponding demand for cooling towers. Past experience, combined with current Marley production to meet this demand, indicates that in many cities, 3 out of every 5 towers sold will be Marley cooling towers.

This overwhelming preference for Marley stems from the fact that Marley towers are accepted as the standard of the air conditioning industry. This acceptance is a result of 25 years of Marley leadership and specialization in water cooling research and engineering . . . of the unique completeness of the Marley line . . . of ready availability from stocks in many cities . . . of guaranteed performance.

Even now, Marley is producing thousands of Aquatowers and natural draft towers to build up stocks in 30 cities. In making plans to capture your share of the market this year, you can count on an adequate supply and "over-the-counter" delivery of Marley towers, the cooling towers with built-in acceptance.

Visit our booth, No. 1043, at the A. S. H. & V. E. Show

MARLEY

The Marley Company

Kansas City 5, Missouri

FOR RADIANT HEATING

choose easy-to-join

CHASE® COPPER TUBE

Easy to make solder joints are all you need with Chase Copper Tube. And a minimum of those! For easy-bending Chase Copper Tube comes in long lengths, cutting down the number of fittings required. There's just nothing better than Chase Copper Tube and its light weight makes it particularly desirable for ceiling and wall installations, too. Write today for FREE 50-page Book on Radiant Panel Heating.

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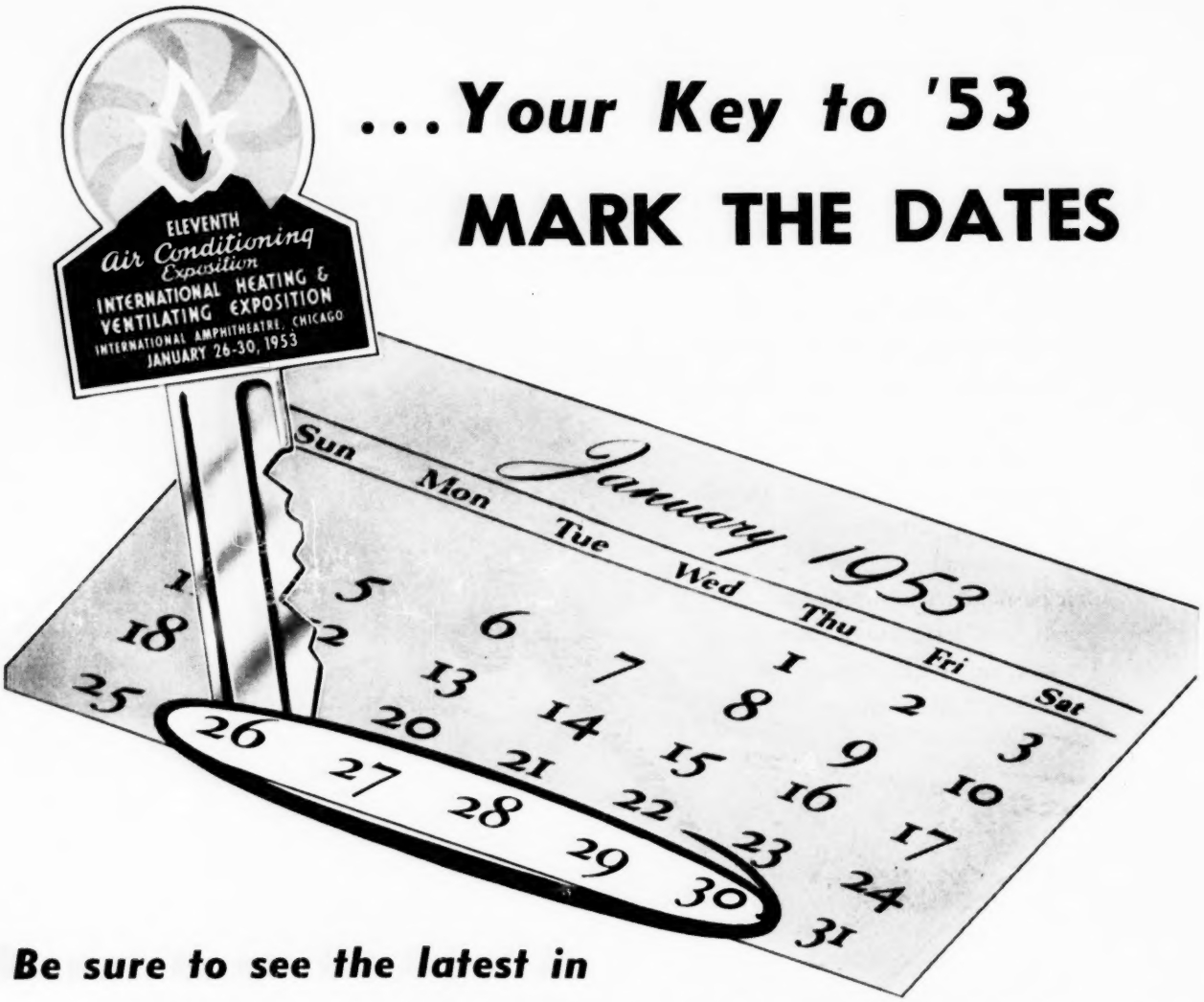
Boston	Detroit	Minneapolis	Providence	
Chicago	Houston †	Newark	Rochester †	(† sales
Cincinnati	Indianapolis	New Orleans	St. Louis	office only)



...Your Key to '53

MARK THE DATES

Be sure to see the latest in

HEATING . . . VENTILATING . . . AIR CONDITIONING

LARGEST SHOW of its kind ever held—11th Air Conditioning Exposition —will fill Chicago's huge International Amphitheatre from January 26-30, 1953.

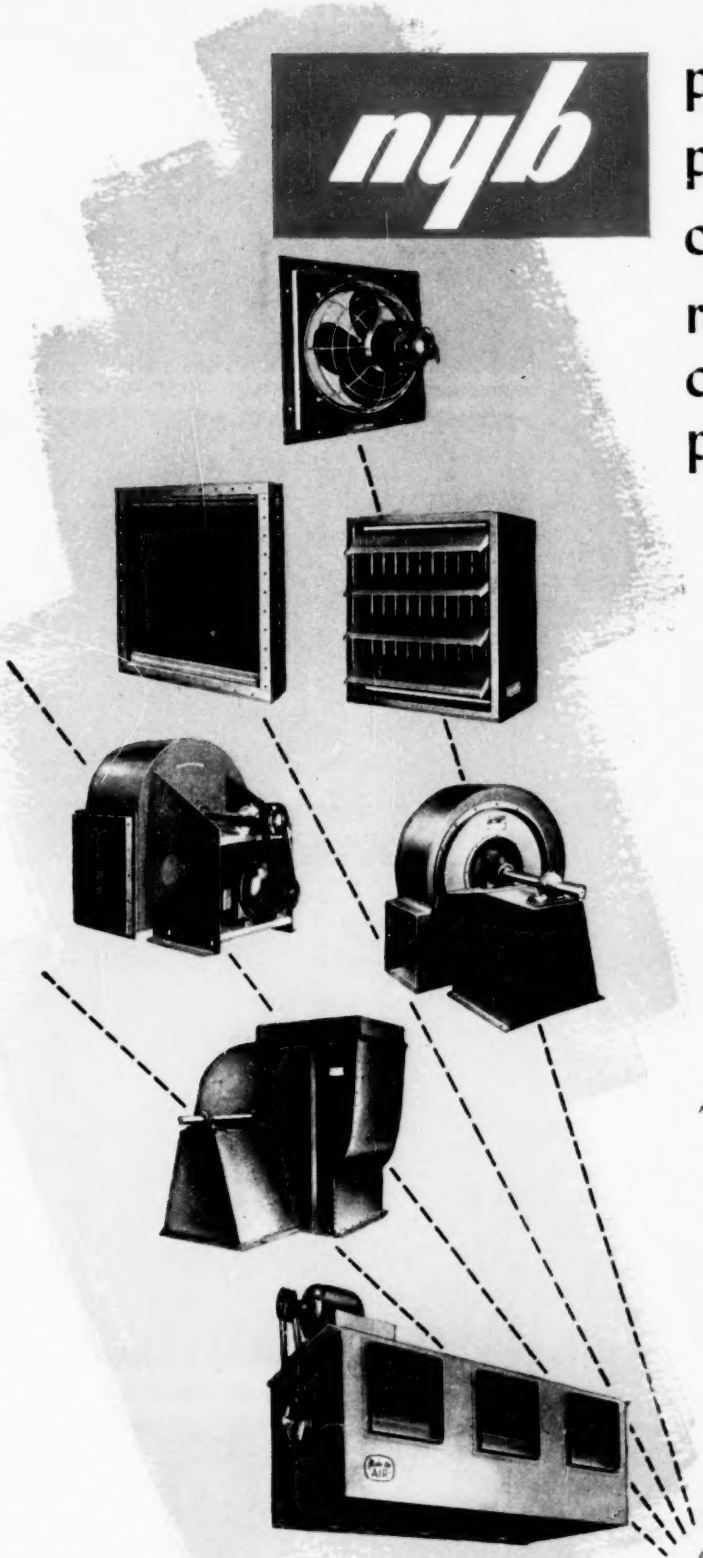
LARGE IN SIZE—More than 300 exhibits—many of them larger than in previous years—will display the latest methods and equipment developed for conditioning air in all types of buildings, plants, and homes . . . hundreds of new, improved items, from complete units to parts.

LARGE IN OPPORTUNITY—You'll have an unequalled opportunity to discuss your plans, problems, and requirements with technical experts who will be staffing the exhibits . . . get practical solutions to current and future problems . . . make many new, valuable contacts . . . come away with a wealth of sound, cost-saving ideas, unavailable anywhere else in so little time.

Arrange *now* to ATTEND and BENEFIT from this unique exposition of IDEAS and PROGRESS.

11th Air Conditioning Exposition
INTERNATIONAL HEATING & VENTILATING EXPOSITION
Under Auspices of American Society of Heating & Ventilating Engineers
MANAGEMENT INTERNATIONAL EXPOSITION CO.

INTERNATIONAL AMPHITHEATRE
CHICAGO
JAN. 26-30



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perfected engineering
precision manufacture
certified ratings
responsible guarantees of dependable performance

Wherever air is handled mechanically, whether for ventilation, heating or process, the name New York Blower enjoys an enviable reputation. ***nyb*** on a product means that the engineering knowledge acquired through over sixty years of manufacturing experience and development is built into it.

Are you using AIR to the best advantage in your production methods to cut costs, increase efficiency, reduce absenteeism, safeguard health, bring comfort to workers . . . or applying it to process control for precision manufacture and more uniform products?

When working on your air handling problems, consult the ***nyb*** representative nearest you in our nationwide service.

●

Be sure to visit us at Booths 1125-27
International Exposition, Chicago
January 26-31, 1953

●

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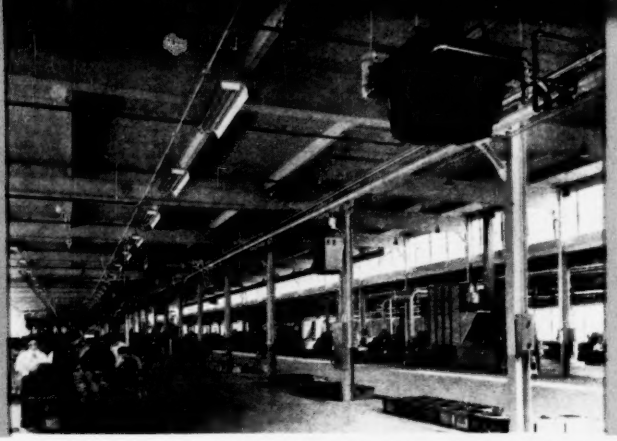
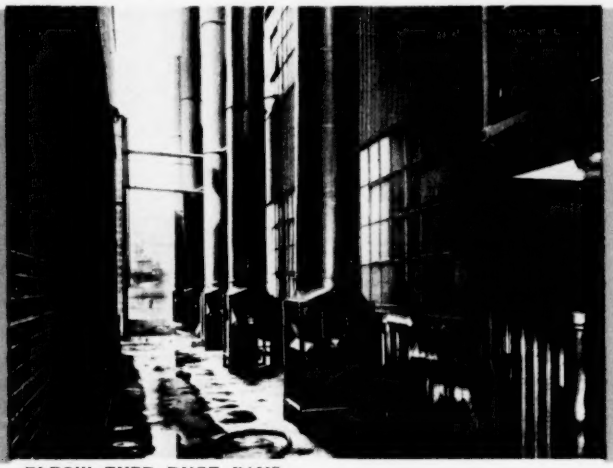
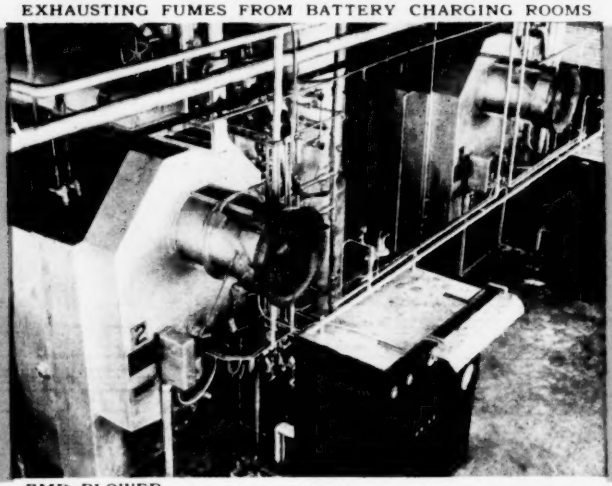


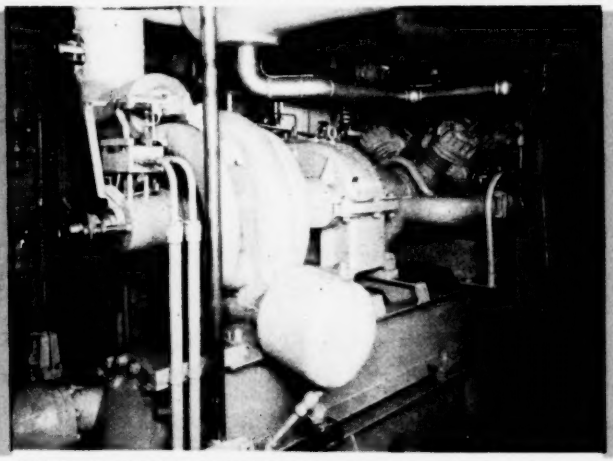
REVOLVING UNIT HEATERS IN LARGE MANUFACTURING PLANT



ELBOW TYPE DUCT FANS
EXHAUSTING FUMES FROM BATTERY CHARGING ROOMS



EMD BLOWER
STANDARD EQUIPMENT ON NATIONALLY KNOWN BOILER



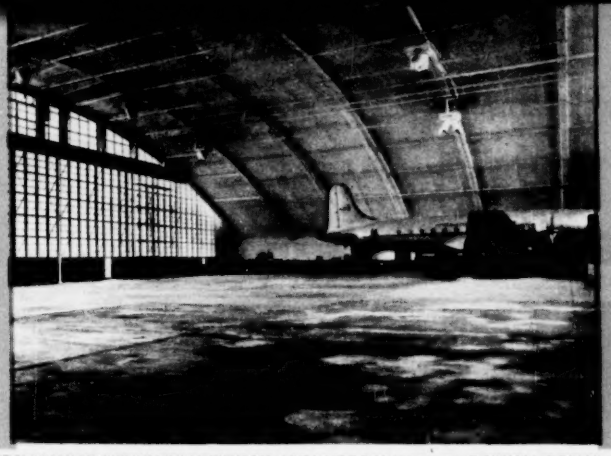
TURBINE DRIVEN COMPRESSOR ON LARGE CARGO CARRIER

L. J. Wing Mfg. Co.

LINDEN NEW JERSEY

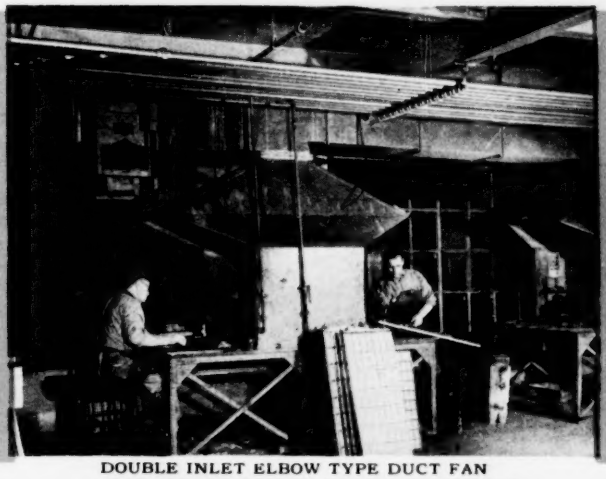
Factories, Linden, N. J. and Montreal, Canada

MANUFACTURING LICENSEE FOR WING UNIT HEATERS IN WESTERN EUROPE— Etablissements—WANSON: Haren-Nord, Brussels, Belgium



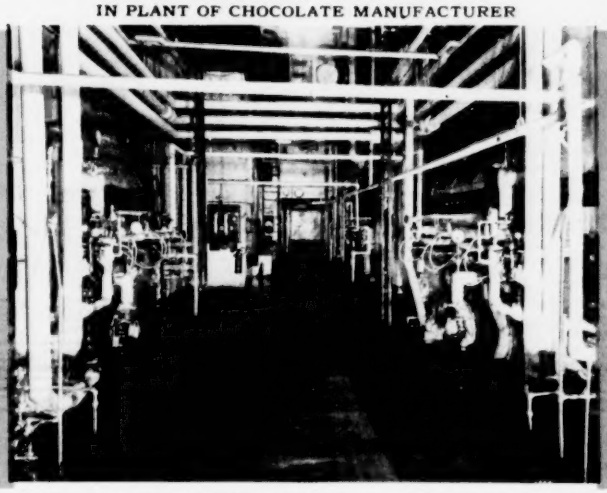
REVOLVING UNIT HEATERS IN AIRLINES HANGAR–DISCHARGE No. 8

WING DOOR HEATERS IN TRANSIT COMPANY'S SHOPS

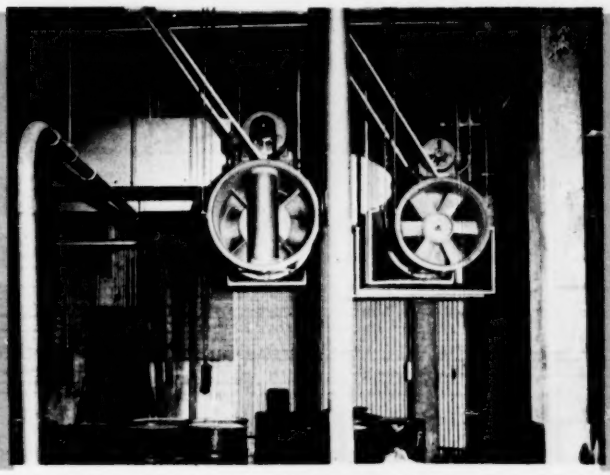


DOUBLE INLET ELBOW TYPE DUCT FAN
IN PLANT OF CHOCOLATE MANUFACTURER

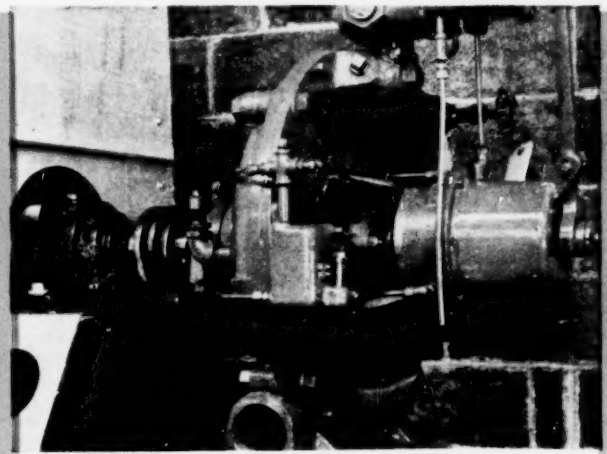
V.T. HEATER SECTIONS IN BATTERY-CHARGING BUILDING



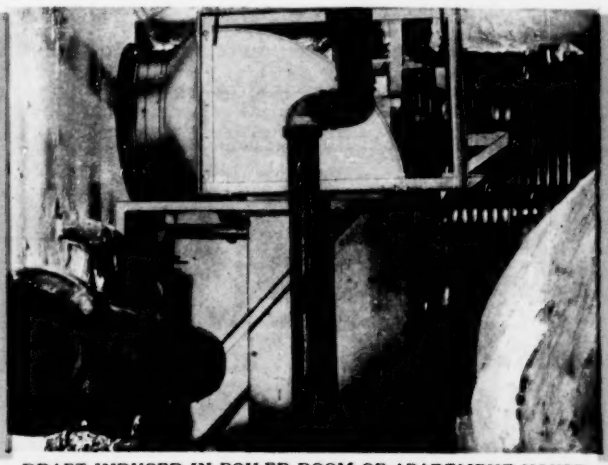
TURBINE BLOWERS IN FIRING AISLE OF LARGE PUBLIC UTILITY



STRAIGHT LINE DUCT FANS CHANGING AIR IN RUBBER FACTORY



TURBINE OPERATING INDUCED DRAFT FAN
IN PLANT OF LARGE MANUFACTURER

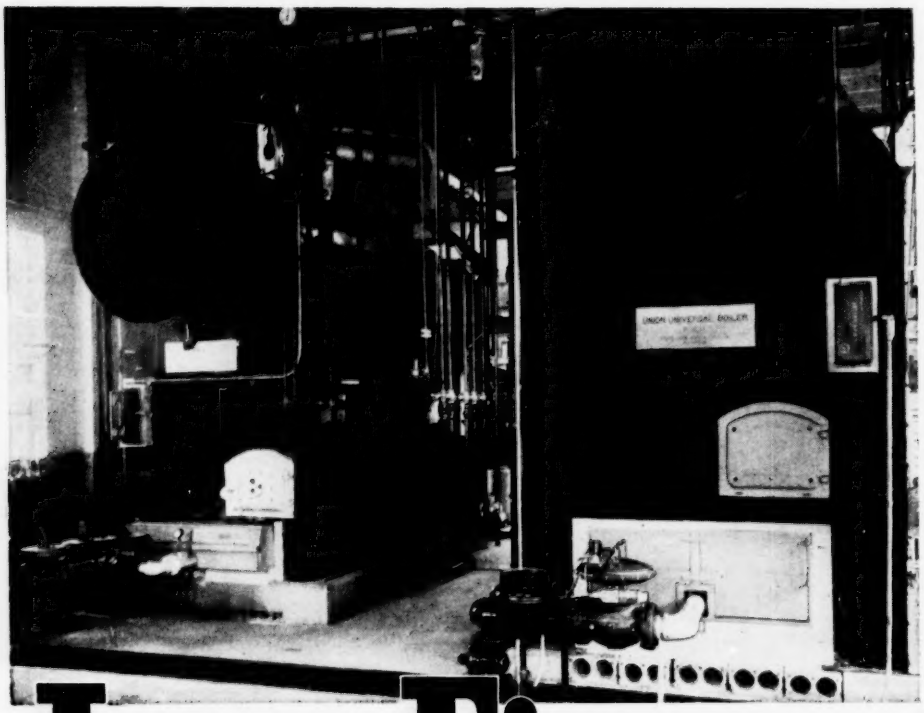


DRAFT INDUCER IN BOILER ROOM OF APARTMENT HOUSE

"Our Iron Fireman Gas Burners maintain a more even steam pressure and save manpower"

says Mr. O. Carlyle Brock
President, Sanida Sanitary Farms Dairy, Inc.
Erie, Pennsylvania

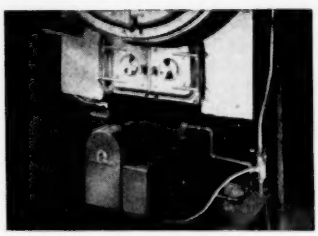
"Our original boilers were coal fired, and since changing to your gas burners, we can maintain a more even steam pressure and are experiencing considerable savings in manpower. Our load changes quite rapidly and at no time have we been held up for lack of steam. We are also able to maintain a clean boiler room which is quite important in dairy operations."



Both boilers at Sanida Dairy (100 h.p. and 150 h.p.) are fired by Iron Fireman GCR vertical-type Gas Burners. Zone fire control permits low-fire start and self-adjusting modulated firing. Automatic damper controls enable rapid heat response.

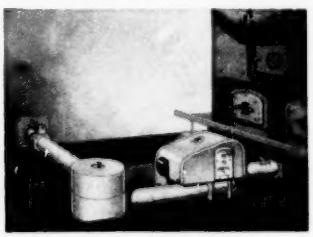
Iron Fireman Gas Firing for heating, power, or processing

Iron Fireman gas firing is saving users many fuel dollars. "Control" is the answer—control of the fuel-air ratio for the most efficient combustion; *control* of the firing rate to instantly adjust to the load; and *control* to compensate for varying pressures in the gas supply. No other gas firing gives such outstanding performance and savings. They are available in three styles—inshot burners, vertical-type burners, and ring-type burners, for boilers up to 1,000 horsepower. Find out how much an Iron Fireman can save for YOU. Phone your nearest dealer or send the coupon below for descriptive literature.



Horizontal Rotary Oil Burner

Fires low-cost, heat-rich heavy oils (Nos. 5 and 6) with complete steadiness and dependability. Oil feed rate is constant, even with changes in viscosity of oil.



Coal-Flow Stoker

Feeds coal direct from bin. No coal handling. Synchronized coal and air supply automatically adjusted to boiler load at all times. Capacities to 400 boiler h.p. Pneumatic Spreader models also available.

MAIL COUPON FOR FULL INFORMATION

IRON FIREMAN MFG. CO., 3282 W. 106th Street, Cleveland 11, Ohio

Please send literature as checked:

- ☐ Commercial Gas Burners
- ☐ Coal-Flow Stokers
- ☐ Rotary Oil Burners
- ☐ Pneumatic Spreader Stokers

Name_____

Address_____

City_____ State_____

AUTOMATIC FIRING FOR HOMES, BUILDINGS, INDUSTRIAL PLANTS

MAINTENANCE CUT When Pump and Motor Use Same Frame and Shaft

ELIMINATE TROUBLES caused by misalignment . . . excessive wear of bearings, packing, and couplings. For lower maintenance, standardize on Allis-Chalmers package pumps . . . the pump with permanent alignment built in.

The complete pumping unit comes to you in one piece. Simply bolt it to the floor, connect power and piping, and you're ready to pump. No special foundation, no couplings or extra parts required.

Both motor and pump are designed together . . . built together by Allis-Chalmers. And there's a nation-wide chain of Certified Service Shops to back up your installations. Built in sizes from 10 to 500 gpm; heads to 220 ft.

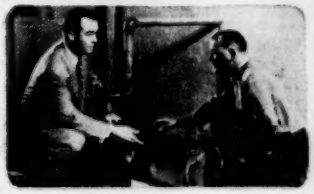
Call your nearby Allis-Chalmers distributor or district office. Or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3872

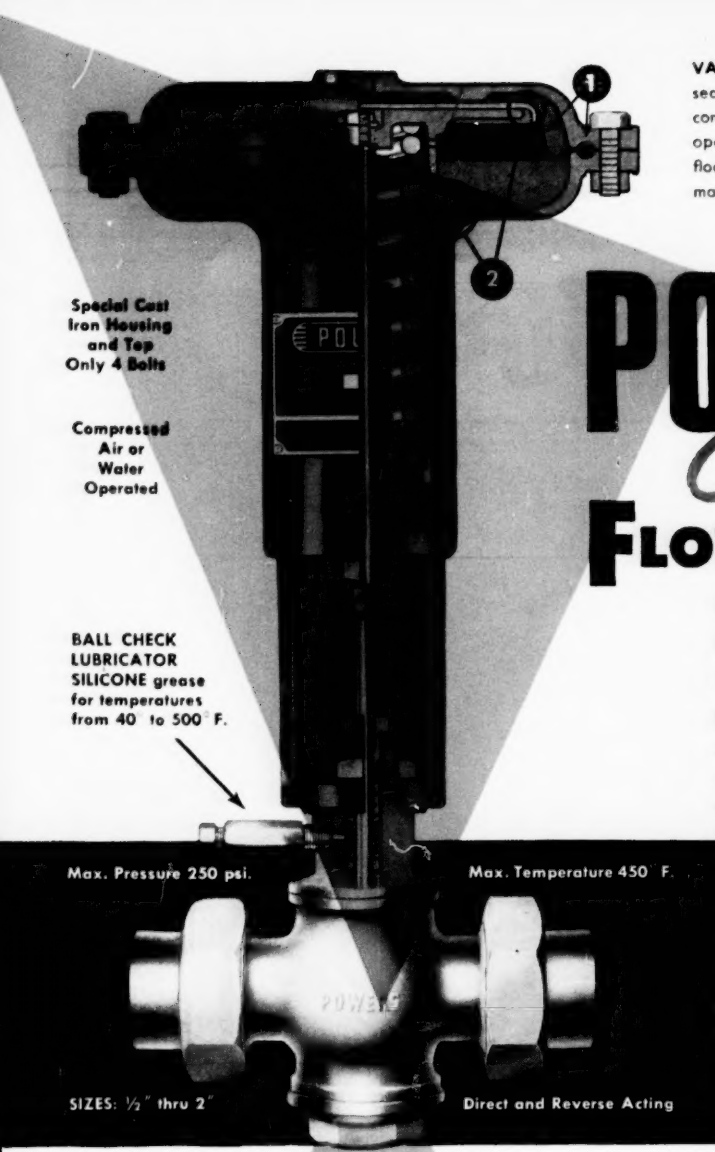
Electrifugal is an Allis-Chalmers trademark.

ALLIS-CHALMERS

NEW PUMP FILMS



See new series of 3 sound-slide films, widely praised by educational and industrial groups. Get practical, instructive information on theory, application, installation and maintenance of centrifugal pumps. Series is designed for showing to maintenance meetings, plant groups, and engineering societies. Arrange now for a showing! Call your nearby Allis-Chalmers authorized distributor or district office. Or write Allis-Chalmers, Milwaukee 1, Wis.

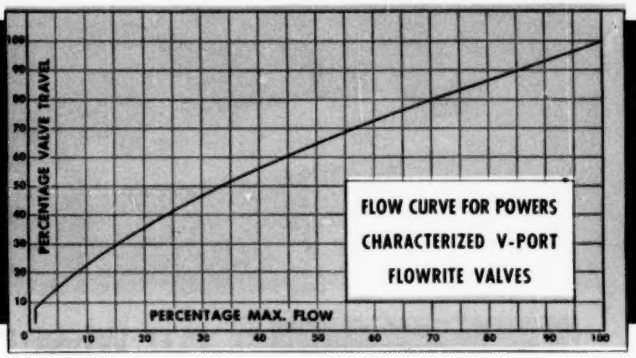

1
2
Special Cast Iron Housing and Top Only 4 Bolts
Compressed Air or Water Operated
BALL CHECK LUBRICATOR SILICONE grease for temperatures from 40° to 500° F.
Max. Pressure 250 psi.
Max. Temperature 450° F.
SIZES: ½" thru 2"
Direct and Reverse Acting

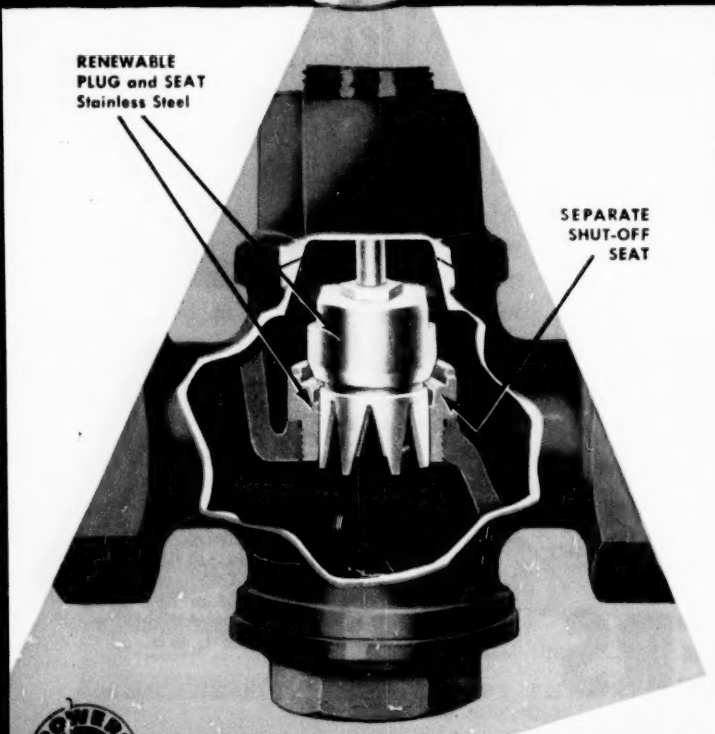
VALVE TOP—Durable moulded neoprene diaphragm (1) has positive sealing bead which provides increased sealing action with increasing control pressure. Efficient diaphragm form insures ample and constant operating power thru full travel. Piston Plate Assembly (2) has a free floating thrust plate which absorbs side thrust. Closely guided piston plate maintains stem in accurate alignment. Maximum air pressure in top, 22 psi.

POWERS® SINGLE SEAT V-PORT *Characterized* FLOWRITE VALVES Give—

Special Flow Characteristics—High lift V-Port plug provides proportional flow throughout entire lift of stem as shown in chart below.

Wide Variety of Valve Sizes—Nine sizes are available, ½" thru 2". The ½" valve can be furnished with plugs to give 15%, 30%, 60% or 100% of maximum capacity. Plugs are easily interchangeable without removing valve from line.





Better Control—Less Maintenance—Superior design of stainless steel plug and seat reduces wire drawing, insures longer life and tight shut off. V-Ports do the throttling, protecting separate shut off seat. Plug and seat are truly removable and can be easily replaced in the field. Inner valves are machined and precision ground and lapped within very close tolerances.

Low Hysteresis—Due to smooth rolling diaphragm and polished stainless steel stem in preformed lubricated packing.

Easy to Adjust—Ball bearing adjusting screw; rust proofed steel calibrated springs with full travel in 5 or 10 psi.

Easy to Install—Powers Flowrite V-Port valves have double unions and bronze body with rugged construction to withstand piping strains.

Easy to Service—Valve and top are easy to take apart and re-assemble, facilitating inspection and maintenance.

Reasonably priced. Contact our nearest office for prices and assistance in selecting proper size valves

THE POWERS REGULATOR CO.

SKOKIE, ILLINOIS • Offices in Over 50 Cities

Chicago 13, Ill., 3819 N. Ashland Ave. • New York 17, N. Y., 231 E. 46th Street
Los Angeles 5, Cal., 1808 West 8th Street • Toronto, Ontario, 195 Spadina Ave.
Mexico, D. F., Apartado 63 Bis. • Honolulu 3, H. I., P. O. 2755—450 Piikoi at Kona

POWERS CONTROL

OVER 60 YEARS OF TEMPERATURE AND HUMIDITY CONTROL

DUCTWORK FASTENED TO CONCRETE IN SECONDS *with* ***DRIVE-IT***

Ductwork goes up faster, easier at less cost when Drive-It is used to anchor it to concrete. Contractors of all building trades speeded their work on the new Lincoln High School at Portland, Oregon, with Drive-It fastening system.

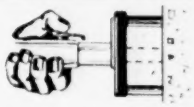
split-second fastening to concrete steel

Drive-It uses a small powder load to drive hardened steel pins into concrete or steel. No power lines! No drilling!

UL

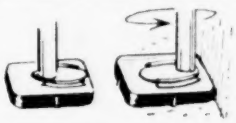
DRIVE-IT is the powder-actuated tool approved by Underwriters' Laboratory.

DRIVE-IT cannot be discharged accidentally due to the push and turn sequence. This, plus the large safety pad makes *DRIVE-IT* triple safe.



Exclusive Automatic Barrel Extension for fastenings inside junction boxes or other recesses.

DRIVE-IT is the only powder-actuated tool which requires but one standard power load regardless of penetration desired.



Exclusive Swivel Safety Pad easily rotated for getting into close quarter work.

DRIVE-IT "300", lowest cost fastening tool. Low original cost and low operating cost.

a drive-pin for every job

OVER 50 TYPES AND SIZES

MAIL THIS COUPON TODAY!

POWDER POWER TOOL CORP.

0712 S. W. Woods St., Portland 1, Oregon

Canada: Ammo Power Tool Co., Ltd.
735 Broadway, Vancouver, B. C.

☐ Please send FREE catalogue and literature.
☐ I want a FREE demonstration of *DRIVE-IT*.

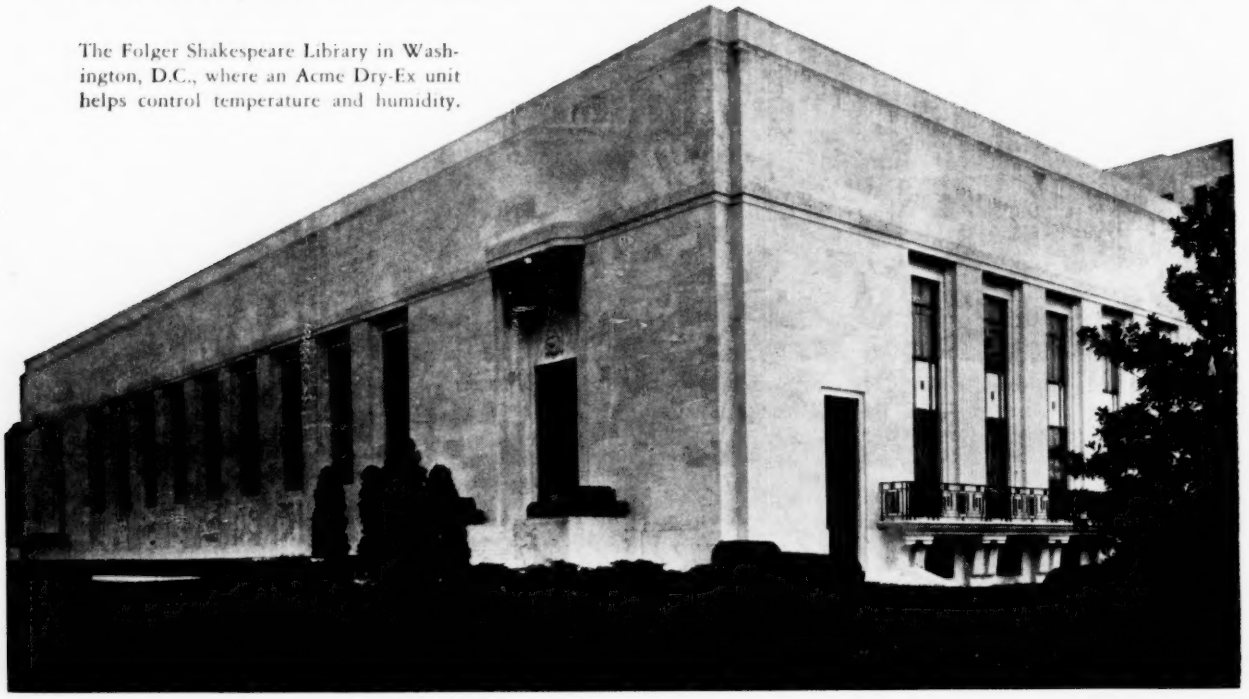
Name _____

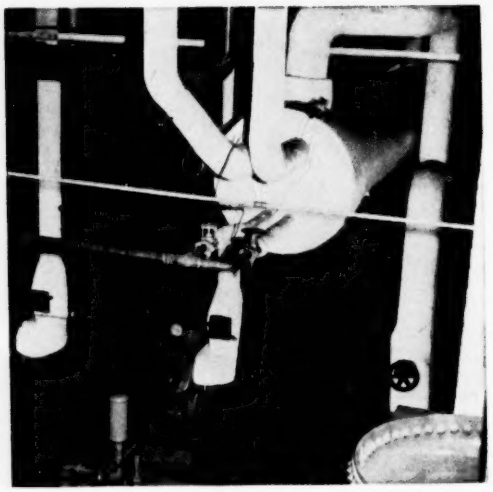
Street _____

City _____ State _____

Acme DRY-EX CHILLER
helps safeguard
$10,000,000 SHAKESPEAREAN COLLECTION

The Folger Shakespeare Library in Washington, D.C., where an Acme Dry-Ex unit helps control temperature and humidity.





The Acme Dry-Ex Ch'ller installed at the Folger Library.

Extremely close year-round control of temperature and humidity is necessary for the protection and preservation of aged parchments and papers. The trustees of the Folger Shakespeare Library in Washington, D. C., recognized this fact in connection with their $10,000,000 collection of literature of the Shakespearean period including 79 of the first folios. The history of Western civilization for the 200 years before 1700 is completely recorded in this collection — one of the greatest in the Western Hemisphere.

The thousands of volumes are located in vaults and rooms spread all over the large building. One room is a full size replica of a 17th century theater. It seats about 200 people and at times has performances held in it. Such variations in space, distance and occupancy placed a heavy load on any air conditioning system installed.

The installation finally decided upon was engineered and designed by the Griffith Consumers Company. It is a 100-ton chilled water air conditioning system that has as one of its component parts a 20" by 14' Acme Dry-Ex Water chiller. This unit was selected for its easy adaptability to variable loads and for its life-long assured, dependable performance.

ACME INDUSTRIES, INC.

Jackson, Michigan

ACME PRODUCTS

CONTINUOUSLY SERVING THE AIR CONDITIONING AND REFRIGERATION INDUSTRIES SINCE 1919

LADISH

Controlled Quality

PIPE FITTINGS

offer dependability safeguarded by advanced metallurgy

Year after year . . . in all kinds of service . . . Ladish Controlled Quality Fittings set new standards of reliability. One reason is the strong reliance on technical progress. Every new facility and advanced technique of modern metallurgy is fully utilized to develop desirable physical properties to maximum limits . . . while unrelenting test procedures continuously safeguard metallurgical soundness and provide users with authentic data proving the complete dependability of every Ladish Fitting.

TO MARK PROGRESS

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF . . . ONE RESPONSIBILITY

LADISH CO.

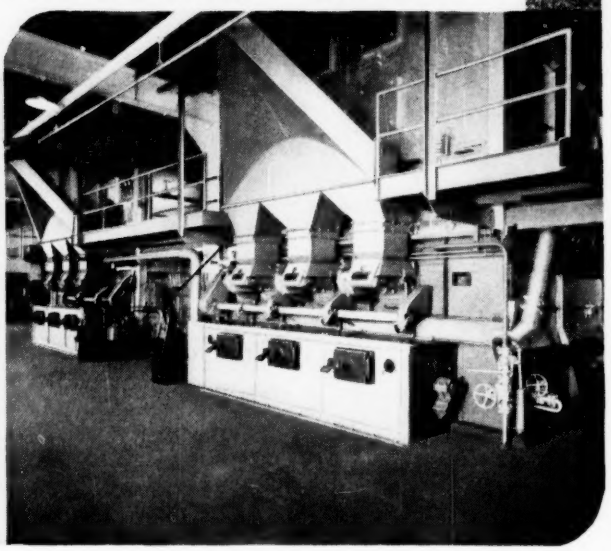
CUDAHY, WISCONSIN
MILWAUKEE SUBURB

District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul
St. Louis • Atlanta • Houston • Tulsa • Los Angeles • San Francisco • Havana • Mexico City • Brantford, Ont.

NEW PLANTS LIKE CATERPILLAR'S BURN COAL THE MODERN WAY!

**Mr. R. H. Bachman,
Plant Maintenance Engineer,
Caterpillar Tractor Co., says:**

"Our new plant pictured above was recently completed at Joliet, Illinois. A completely up-to-date coal installation was chosen to handle the heat and process steam requirements. To the right is a picture of the firing aisle showing how the boilers are fed by dust-tight chutes from overhead bunkers. This modern equipment makes coal as clean, convenient, and efficient as a fuel can be! The boilers are rated at 80,000 lbs. of steam per hour, but have handled loads as low as 3,000 lbs. per hour without difficulty."



For big savings, build for COAL! That's a good rule to follow whether you've got a new plant under construction or an older plant being modernized.

Up-to-date coal-burning equipment can give you more steam per dollar . . . modern coal- and ash-handling systems can cut labor costs to a minimum. In addition, coal is the only fuel with virtually inexhaustible reserves. And to mine this coal, to better prepare it for customers' special needs, America has the world's most productive coal industry. Thus, coal users get a double advantage—*dependable supply of an ever better product, at relatively more stable prices.*

For heat, power, process steam—coal is your best bet! Ask a consulting engineer. He'll show you how to cut both fuel and operating costs by burning coal in a modern plant designed to meet your specific needs.

If you operate a steam plant, you can't afford to ignore these facts!

COAL in most places is today's lowest-cost fuel.

COAL resources in America are adequate for all needs—*for hundreds of years to come.*

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

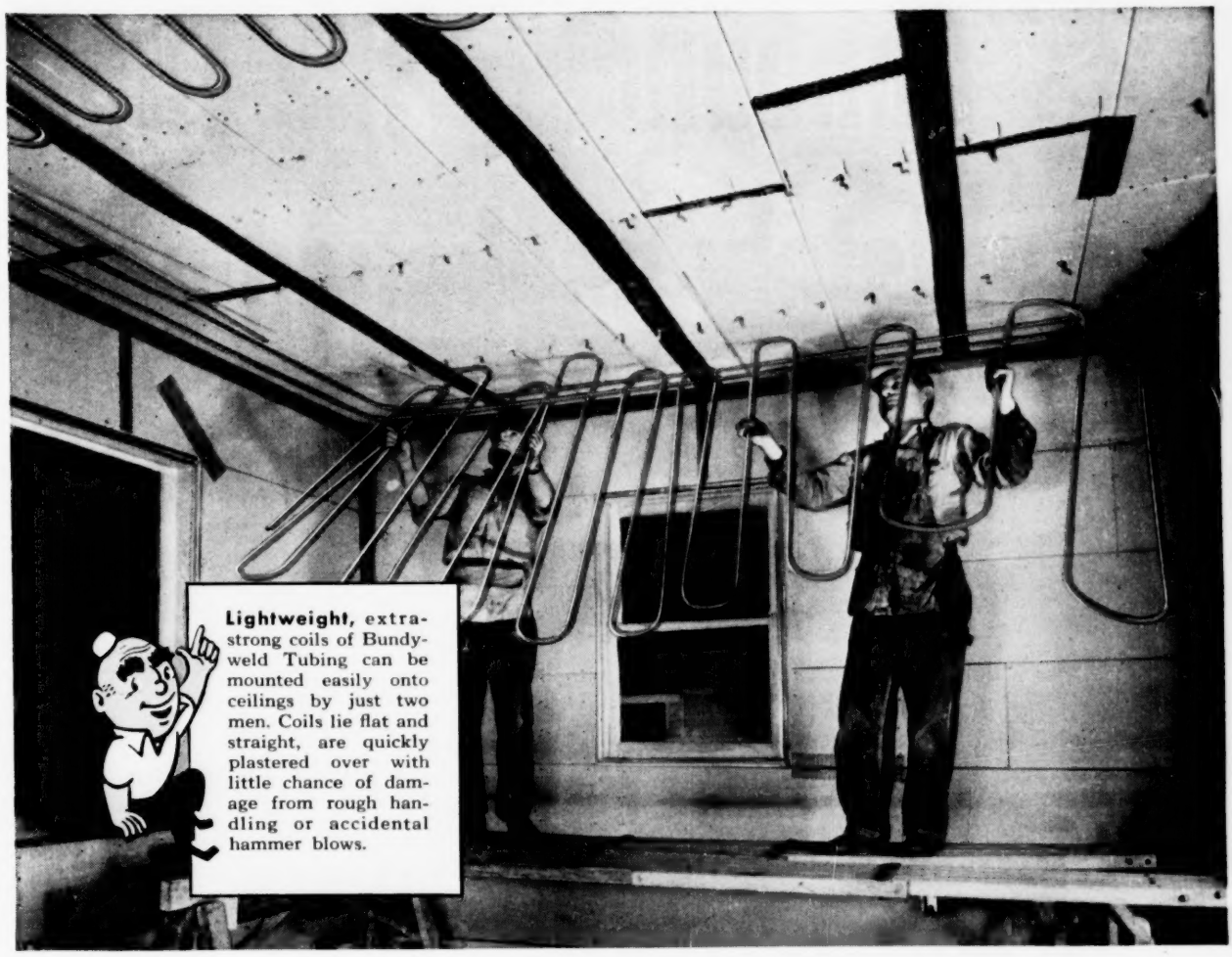
COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

BITUMINOUS COAL INSTITUTE

A Department of National Coal Association, Washington, D. C.

FOR HIGH EFFICIENCY FOR LOW COST

YOU CAN COUNT ON COAL!



Lightweight, extra-strong coils of Bundyweld Tubing can be mounted easily onto ceilings by just two men. Coils lie flat and straight, are quickly plastered over with little chance of damage from rough handling or accidental hammer blows.

Leave your competition in the lurch: check into Bundyweld Ceiling Radiant Heating

Key to Low Cost

Bundyweld is the only tubing double-walled from a single strip, copper-brazed through 360° of wall contact. It's leakproof, thinner walled, yet stronger. It transmits heat quickly, has high bursting strength. It saves on material costs and installation time.

Standard 20′ lengths of Bundyweld are easily formed into coils in shop or on job site. Expanded ends (furnished when specified) are quickly soldered into leakproof union. Joined, lightweight coils are easily mounted onto ceiling, quickly plastered over.

Here's a sure way to step right out in front of your competition and *stay* in front.

Take on Bundyweld Ceiling Radiant Heating. Here's heating so comfortable, so clean, so convenient and so inexpensive it's making all other heating methods obsolete.

The thousands of users enjoying it are passing the good word around to their friends. The millions of readers of *Better Homes & Gardens, American Home,* and *House Beautiful* are learning about it from Bundy ads. They're sending in a landslide of coupons requesting literature. They're asking for the names of plumbing and heating contractors in their areas who handle Bundyweld Ceiling Radiant Heating.

Take this important step toward outdistancing your competitors—with the first really exciting heating development in years. Send coupon today for free literature.

Radiant Heating Division

BUNDY TUBING COMPANY

Detroit 14, Michigan

SEND FOR FREE LITERATURE!

Bundyweld
Ceiling Radiant Heating

→ Radiant Heating Division, Dept. HV-153
Bundy Tubing Company, Detroit 14, Mich.

☐ Send free 20-page nontechnical brochure explaining Bundyweld Ceiling Radiant Heating.

☐ Send Bundy technical radiant heating pamphlet.

Name _____ Title _____

Company _____

Address _____

City _____ Zone _____ State _____

Announcing the TRANE completely packaged water

New TRANE Cold-Generator . . . A complete reciprocating refrigeration machine including compressor, condenser, refrigerant piping, liquid-suction interchanger, liquid cooler, control valves, motor and accessories . . . all interconnected and ready for immediate air conditioning or processing application.

See it operate at the 11th International Air Conditioning Exposition!

It'll be there, connected and operating, in Booths 615 and 627, International Amphitheatre, Chicago, January 26-30.

new

MANUFACTURING ENGINEERS OF AIR CONDITIONING, HEATING AND VENTILATING

COLD-GENERATOR chiller.....ready to install !

COMPLETELY WIRED, PIPED, REFRIGERANT-CHARGED

Now you can install a complete refrigeration cycle, factory engineered, factory assembled, factory tested, factory guaranteed. A single unit providing chilled water for air conditioning. A single unit providing undivided responsibility!

In other words, you can now install mechanical refrigeration for air conditioning systems without refrigerant piping, on-the-job pressure testing, evacuating, dehydrating or refrigerant-charging.

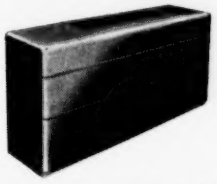
In this one compact unit—the new TRANE COLD-GENERATOR—you get the reciprocating compressor, condenser, refrigerant piping, liquid cooler, control valves, motor and accessories. These field-proven components are wired, piped and refrigerant-charged. All are carefully engineered and *exactly matched.*

Rugged, yet lightweight, TRANE COLD-GENERATORS are compactly built for small space installation. Ten sizes—from 10 to 100 tons—all requiring only simple plumbing and electrical connections to put them in service.

It is now easy for you to install efficient, economical, dependable air conditioning systems in office buildings, theaters, hotels, auditoriums, department stores . . . everywhere!

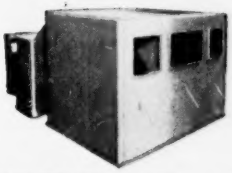
Get complete information at once on this new idea in packaged refrigeration. Learn how the TRANE COLD-GENERATOR makes air conditioning as easy to install as heating! Packaged refrigeration brings you packaged responsibility—and packaged profits too!

Combines with these Trane products for a complete air conditioning system . . .



UniTrane . . . Units with individual control of heating, cooling for multi-room system.

Climate Changers . . . Basic air conditioners containing coils, fans, humidifiers, filter, dampers.



Multi-Zone Climate Changer. . . . Single unit provides different temperatures simultaneously to as many as 8 zones.

TRANE Cold-Generator

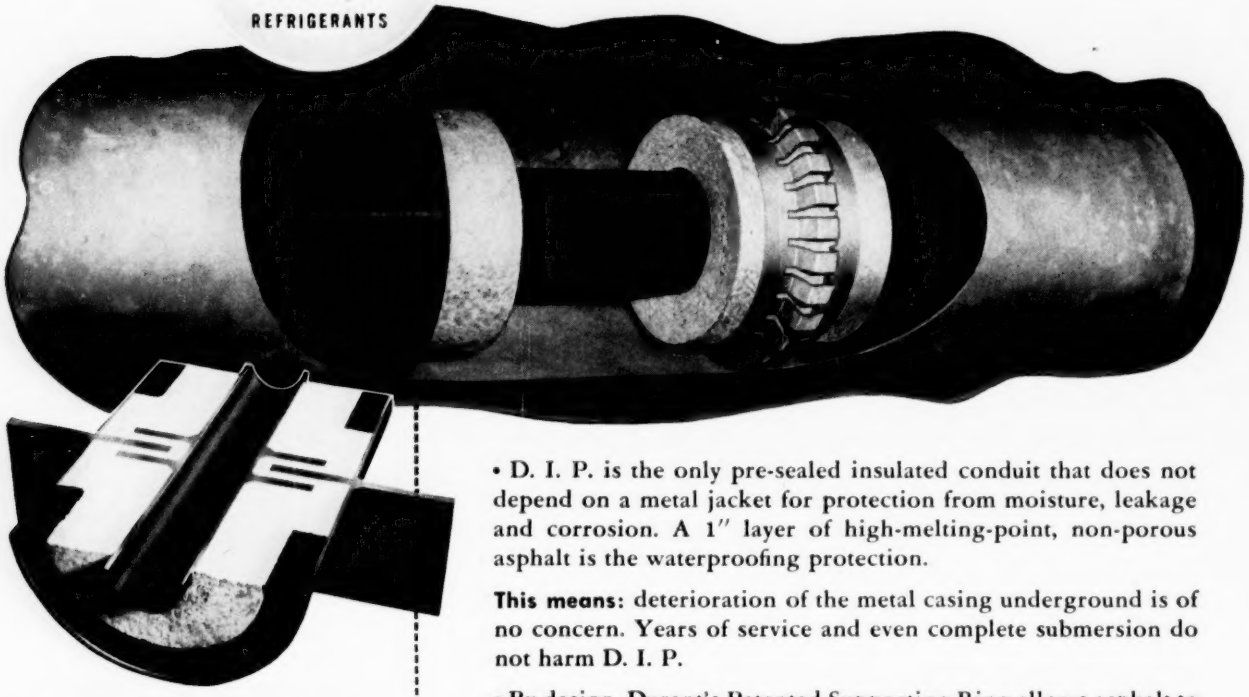
brings you chilled water for air conditioning in a package

EQUIPMENT The Trane Company, La Crosse, Wis. • East. Mfg. Div., Scranton, Penn. • Trane Co. of Canada, Ltd., Toronto • 80 U.S. and 14 Canadian Offices

D.I.P.®

FIRST IN THE FIELD OF PRE-SEALED INSULATED PIPING FOR STEAM HOT WATER REFRIGERANTS

Only DURANT Pre-sealed Insulated Pipe gives you these features:



Durant Patented Insulated Anchor

Inspection of D. I. P. after 15 years' service revealed no sign of corrosion, no loss of insulation efficiency, no breaks in asphalt. Note backfill of refuse building materials. Installation is on former city dump.

• D. I. P. is the only pre-sealed insulated conduit that does not depend on a metal jacket for protection from moisture, leakage and corrosion. A 1″ layer of high-melting-point, non-porous asphalt is the waterproofing protection.

This means: deterioration of the metal casing underground is of no concern. Years of service and even complete submersion do not harm D. I. P.

• By design, Durant's Patented Supporting Ring allows asphalt to flow through openings during fabrication to *encase* the ring.

This means: water or moisture cannot pass through support points to the insulation or pipe. It means efficient insulating properties and extreme durability.

• Durant's Patented Insulated Anchor eliminates contact between anchor plate and pipe.

This means: reduced heat loss and elimination of corrosive electrolytic action at anchor points.

Many other advantages come with D. I. P.—such as low cost installation, for the Durant field joint can be made swiftly and easily. D. I. P. does not require external casing-welding: nor does it require concrete tunnels, slabs, rollers, supports, drains or additional protection for superimposed loads—such as under roadways or railroad tracks. Steam pressures to 1000 psi.

Durant's engineering staff and representatives are at your service. Write us today for Catalog G-1.

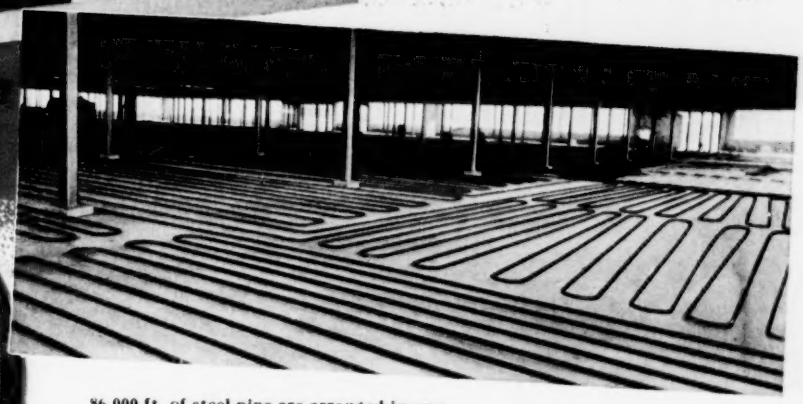
Representatives in Principal Cities

PRE SEALED®

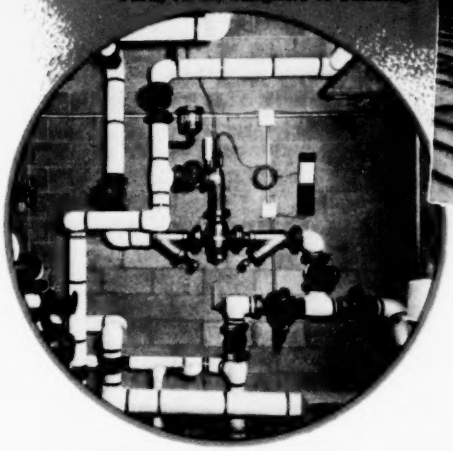
Western Division: **DURANT INSULATED PIPE COMPANY**
WARREN WAY AND BAY ROAD, PALO ALTO, CALIFORNIA

Eastern Division: **DURANT INTERNATIONAL CORPORATION**
WILLIAMSTOWN, NEW JERSEY

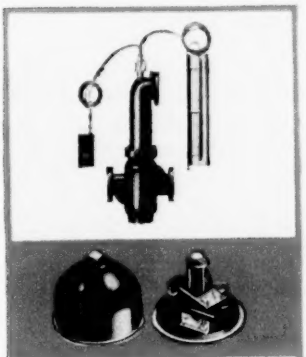
Sarcotherm Heat Control System chosen for POTDEVIN MACHINE COMPANY'S LARGE PLANT at Teterboro, N. J.



86,000 ft. of steel pipe are arranged in serpentine coils for the radiant heating system. Heating Contractor, Frank Lawton, Paterson, N. J



One of the 5 Sarcotherm Control valves, protected by strainers. A Sarcotherm Air Eliminator will be noted at the right.



The heart of the Sarcotherm control system is this unique control valve. It is actuated by liquid expansion thermostats, one located outside the building and one in the valve itself. Between them they anticipate changes in heat loss ratio, thus maintaining comfort temperatures under all conditions.

The Sarcotherm Comfort Control "Thermoray" is an extremely sensitive thermostat affected by both radiation and convection

This latest addition to the industrial plants at Teterboro terminal covers an area of 102 thousand square feet.

The single story building is radiant heated by floor coils requiring 86,000 feet of pipe.

The system is divided into five zones, each controlled by a 3″ Sarcotherm Control Valve, type STA-1D, with Thermoray heat-loss thermostat for each zone.

Sarcotherm also furnished Sarcoflow balancing fittings, access boxes, strainers and other accessories.

This is the largest single story industrial building in the East, radiant heated by floor coils.

We are proud that

Sarcotherm Control

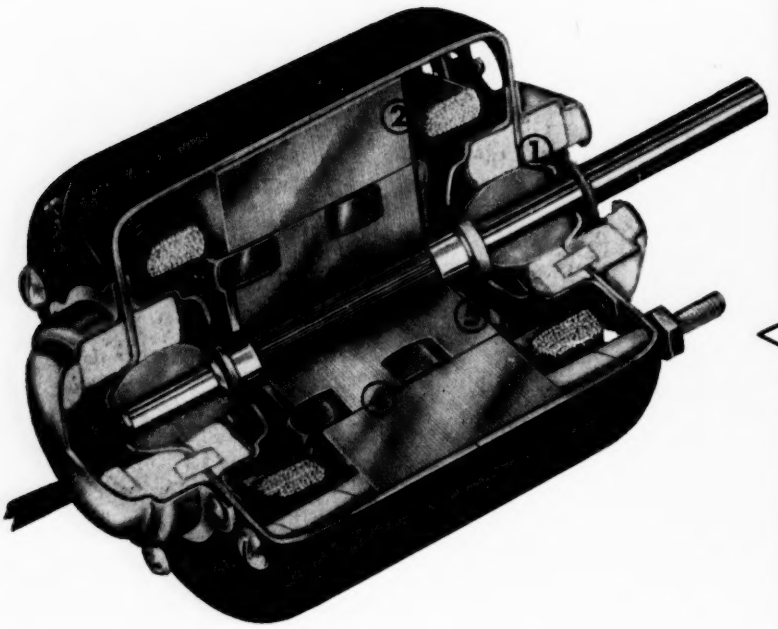
was selected for this outstanding job. Individually engineered Sarcotherm Control systems are available also for conventional forced Hot Water or Steam Heating Systems. Our Engineering Department will be glad to assist on your next job.

24

Sarcotherm CONTROLS, INC.

EMPIRE STATE BUILDING · NEW YORK 1, N. Y.

A SARCO PRODUCT



1. Extra-large bearings and oil reservoirs . . . for smooth operation and long life.
2. Deep varnish impregnation and baking improve dielectric, physical, and radiating qualities of stator-and-coil assemblies . . . for trouble-free, quieter, cooler performance.
3. Rotor-and-shaft assemblies dynamically balanced—exactly . . . for freedom from vibration.
4. Precisely held over-all concentricity maintains a constant air gap...for smoother, quieter operation.
5. Instead of cheaper rotors of substitute materials, Fasco uses welded copper rotors . . . for more efficient performance.

A motor is the Sum of all its Parts

This is one Fasco shaded pole motor, cut away to show only five of the features developed through years of experience in making millions of motors — *specialized* experience aimed principally at perfection of the shaded pole type.

These five features could have been fifteen or fifty, for at Fasco mass production of small motors is a total performance of many individual precision steps — in design, material selection, fabrication, assembly and quality control.

There is one feature that can't be shown in any typical sketch—the Fasco feature that's more important to you than any of the others. It is the individual tailoring of a motor produced in volume — a motor engineered to fit the needs of *your* application.

The tailoring is based on study of your application—in Fasco laboratories or in your plant—with actual motors working in your product under normal and abnormal conditions. Such tests may indicate a design adaptation involving a change as simple as a few turns more or less of wire in the coils—or more complex modifications may be needed.

The result is a power source engineered for top efficiency and dependable performance in *your* product—a motor custom-built at a mass production cost.

We'll be glad to hear about your problem. Just write.

FASCO
INDUSTRIES, INC.
ROCHESTER 2, NEW YORK

SPACE 1020

INTERNATIONAL HEATING and VENTILATING EXPOSITION

International Amphitheater, Chicago
January 26 – 30

Small motors and blowers for industry

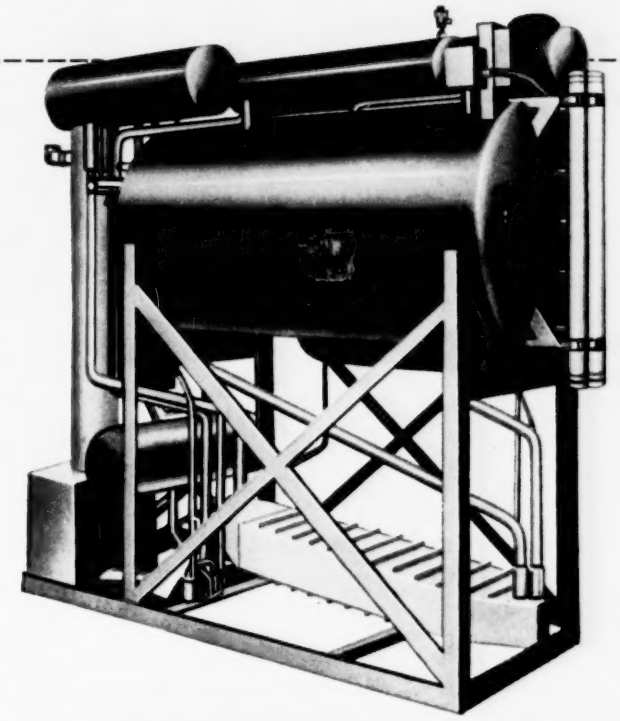
Solve cooling problems with waste heat or low-cost steam!

FLEXIBLE

SERVEL

WATER CHILLER

meets all 3
cooling needs

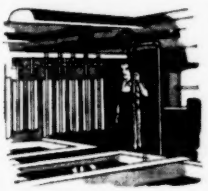


5-YEAR WARRANTY! Every Servel 25-ton Water Chiller is backed by a full 5-year warranty. Because it has no moving parts, the Servel Water Chiller operates quietly and without vibration. Add to these advantages its extremely compact size and light floor weight and you'll appreciate why it can be installed on any floor with most economical piping arrangement. May be installed singly or in multiple as required. Mail the coupon below today for complete information.

1. AIR CONDITIONING

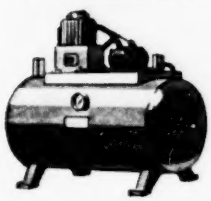
The adaptable Servel 25-ton Water Chiller—operating on any source of steam—uses water as the refrigerant to provide economical temperature and humidity control in large buildings and factories. No expensive duct systems are required!

2. PROCESS COOLING



Because it operates with no moving parts on the time-proved absorption refrigeration principle, you can depend upon the Servel 25-ton Water Chiller for continuous high-efficiency cooling of liquids for various manufacturing and formulating processes.

3. INDUSTRIAL PRECOOLING



You can use the unusually flexible Servel 25-ton Water Chiller to precool air for increased capacity and improved performance of air compressors and internal combustion machines. The Water Chiller also serves other money-saving precooling purposes.

Servel

the name to watch for great advances in . .

AIR CONDITIONING ✓ REFRIGERATION

MAIL THIS COUPON TODAY

SERVEL, INC., Dept. HV-1, Evansville 20, Indiana

Please send me further information about application flexibility of the Servel 25-ton Water Chiller.

Name _____

Firm _____

Address _____

City _____ Zone _____ State _____

Simplify PUMP SELECTION with DEMING PUMP DATA

Quick access to facts about a wide variety of Deming Pumps is available to you in the series of illustrated bulletins listed at the right.

Use of this data simplifies the problem of selecting the most suitable pumping equipment for specific conditions.

Any or all of these informative bulletins will be furnished gratis. Suggestion: check bulletins you desire in list at right, attach to your letterhead and mail to us.

THE DEMING COMPANY
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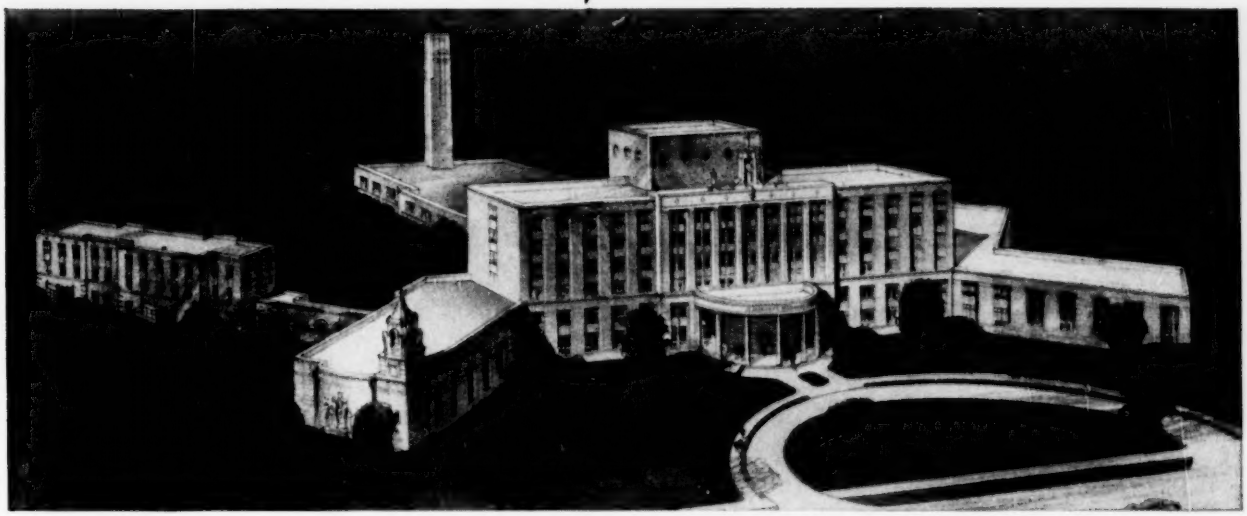
DEMING

CATALOG NUMBER	TYPES OF PUMPS	RANGE OF CAPACITIES
3300-B	Self-priming Centrifugal Pumps. Priming is rapid, automatic and fool-proof.	10 to 300 G. P. M. and heads to 250 Ft.
3900-B	Side suction Centrifugal Pumps. Single and Two Ball Bearing types.	Up to 200 G. P. M. Sizes ½", ¾", 1", 1½" and 2" discharge.
4010-A	Side suction Centrifugal Pumps. Single Ball Bearing. Electric motor, belt, or gasoline engine drive.	10 to 3600 G. P. M. Sizes 1" to 10" discharge.
4012-A	Side suction Centrifugal Pumps. Two Ball Bearing type with separate liquid end. All types of drive.	10 to 3600 G. P. M. Sizes 1" to 10" discharge.
4013-A	Side suction Centrifugal Pumps. Two Ball Bearing type. Electric motor, belt, or gasoline engine drive.	10 to 1200 G. P. M. Sizes 1" to 6" discharge.
4303	"Motor-Mount" Centrifugal Pumps. Can be mounted in vertical or horizontal position.	5 to 600 G. P. M. Heads up to 180 ft. 63 sizes of pumps.
4350	"Motor-Mount" Centrifugal Pumps. Vertical and Horizontal types. NEMA type "C" mounting flange.	Up to 200 G. P. M. Heads up to 165 ft. 25 sizes of pumps.
5004-A	Single stage, split case Centrifugal Pumps.	25 to 4000 G. P. M. Heads up to 300 ft. Full range of sizes.
4700	Vertical Multi-stage Centrifugal Pumps for wells 4" to 16" or larger.	15 to over 3000 G. P. M.
4600-A	Sump Pumps and Cellar Drainers. Various types including units with NEMA type "C" mounting flange.	Up to 3000 G. P. M. Full range of sizes.
4400	Condensation Return Units and Boiler Feed Pumps.	Wide range of sizes and capacities.
CATALOG C-52	A complete line of pumps and water systems for shallow and deep wells.	240 to 3600 gallons per hour and larger.

Pumps and Water Systems

ILLINOIS ZONE CONTROL



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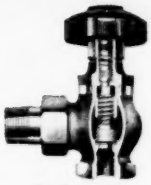
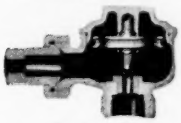
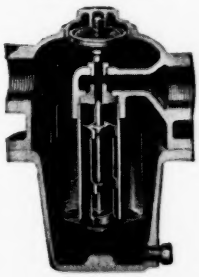
Architect: HENRY R. SLABY, A. I. A., Milwaukee, Wisconsin
Heating Contractor: PETERSON PLUMBING AND HEATING, Centralia, Ill.



Series 48
Radiator Valve



Series G
Radiator Trap



Series G
Float and
Thermostatic Trap

See our exhibit
Booth 1142
International
Exposition, Chicago
January 26-31

An ILLINOIS High Vacuum Heating System perfectly controlled assures maximum fuel economy, comfort and convenience in this new hospital, convent, chapel group.

Steam is supplied from a high pressure boiler plant, with pressure reduced to two or three pounds for the heating, ventilating and air conditioning.

The hospital is heated with a four-zone ILLINOIS Type A Pneumatic Control System governed by electronic outdoor-indoor controllers. Operating rooms and maternity wards are heated by separate systems with individual control. The convent is equipped with a two-zone Cycling Flow Control System controlled by Type E-4 electric valves with two-stage thermostat and immersion stat.

Other ILLINOIS Heating Systems include Type C Generation Control as well as the Standard Vacuum and Vapor Systems.

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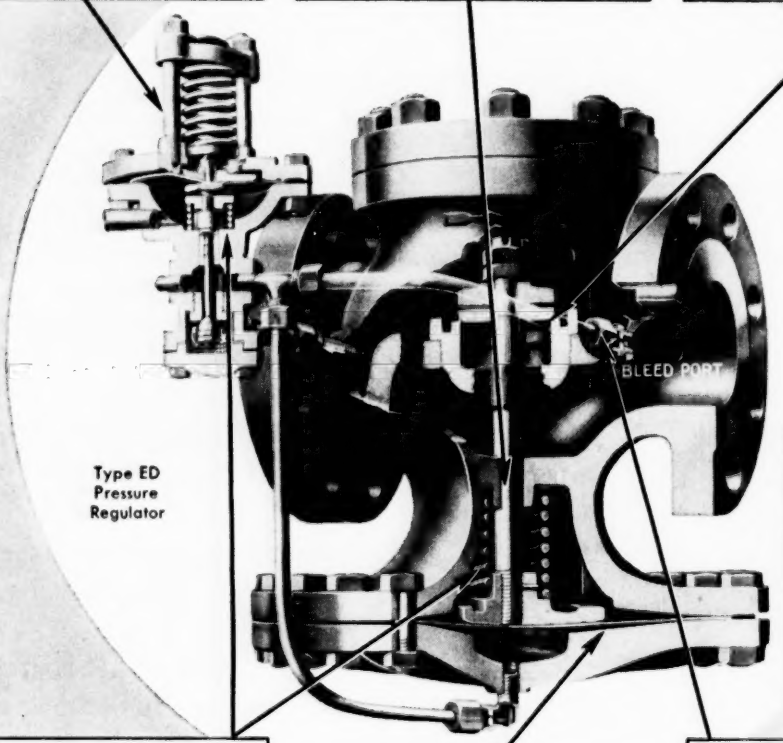
INCORPORATED 1900
RACINE AVENUE AT 21ST STREET • CHICAGO 8

ONLY SPENCE REGULATORS ...give you all these design advantages

Separate Interchangeable Pilot . . .
controls main valve . . . simplifies inspection and maintenance.

Packless Construction . . .
minimizes friction . . . improves control accuracy and eliminates much time-consuming maintenance.

SECO Metal Seats and Discs . . .
resist wiredrawing. More than 20 years of experience has failed to produce a single case where SECO Metal was cut by steam.



Type ED Pressure Regulator

Dead-End Shutoff . . .
guaranteed on steam service when a balanced, single-seated main valve is equipped with SECO Metal seat and disc and is protected by an approved strainer.

Internal Springs . . .
out of path of steam or other fluid flowing through the valve. They operate at low unit stress for exceptionally long life.

Large Balanced Metal Diaphragms . . .
located in a cooled zone with a condensate seal above and below, under usual conditions, never need replacement.

Ease of Inspection . . .
quick access to all vital elements of regulator. No special tools needed.

These Spence design features explain why Spence Regulators function dependably and accurately year after year, without requiring extensive repairs or special attention. This lowers over-all costs . . . means less down-time of the system. • Spence makes a complete line of automatic regulating valves: pressure reducing, differential pressure, back pressure control, pump governor, temperature regulating and other types. Write for Bulletin giving full details.

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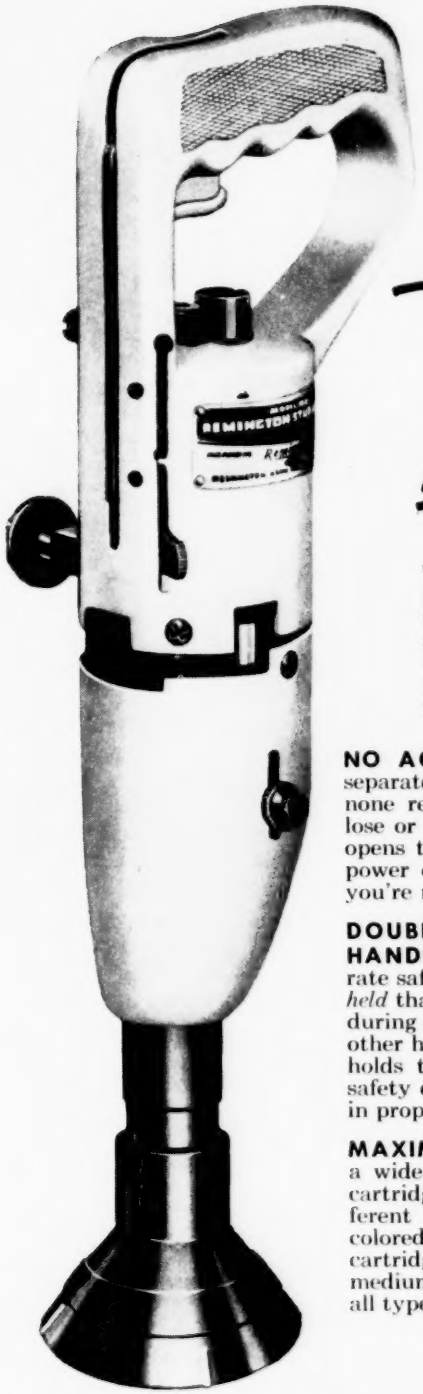
SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

SE 122

MODEL 450 REMINGTON STUD DRIVER



—the ONLY powder-actuated fastening tool with ALL these advantages—

The Model 450 Remington Stud Driver sets up to 5 fastening studs per minute—a speed unmatched by other powder-actuated tools. Completely self-powered, this amazing tool fastens steel or wood structural pieces to concrete or steel surfaces in seconds. Its light weight—only 5½ pounds—makes it ideal for use overhead or in confined spaces. Check these other exclusive Remington Stud Driver features:

NO ACCESSORIES REQUIRED. No separate parts needed to control power, none required for loading—nothing to lose or break. Just a twist of the wrist opens the Model 450. Insert stud and power cartridge as a unit . . . close and you're ready! Whole job takes seconds.

DOUBLE-SAFE—REQUIRES *BOTH* HANDS FOR OPERATION. A separate safety lever must be depressed and *held* that way with one hand before and during squeezing of the trigger with the other hand. Safe, two-handed operation holds the tool steady. Two *additional* safety devices prevent operation except in proper fastening position.

MAXIMUM POWER RANGE. You get a wide choice of power in Remington cartridges. They're available in six different loads, each clearly marked by colored plastic heel caps. The 32 caliber cartridge gives you extra power in this medium-duty tool . . . helps you speed all types of fastening jobs.

ARROW-STRAIGHT DRIVING—BETTER GAS SEAL. New, long plastic heel cap on all Remington cartridges provides perfect gas seal . . . gives the Model 450 more power. Assures controlled, consistently straight driving.

FAST, POSITIVE EJECTION. Exclusive ejector snaps fired case out of tool instantly—no fumbling, no tools needed.

Test-proved to be the world's finest and speediest fastening system, the Model 450 Remington Stud Driver is made by the Remington Arms Company, Inc., *America's oldest and foremost sporting arms manufacturer.*

NEW, FREE BOOKLET shows you a hundred different ways the Model 450 Remington Stud Driver can speed *your* construction fastening. Packed with illustrations, it tells you where and how this tool can save time, reduce fatigue and cut costs. Send in the coupon below for your copy.

Listed & Approved by Underwriters' Laboratories, Inc.

"If It's Remington—It's Right!"

Remington

DUPONT

MAIL THIS COUPON TODAY

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Please send me my *free* copy of the new booklet showing how I can cut my fastening costs.

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Position _____

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The HIGH-STRENGTH SHEET *is Galvanized Steel*

Of all the materials used for ordinary sheet-metal work, steel is the strongest and stiffest.

This means that galvanized steel has less tendency to buckle or kink when it is handled. It usually requires less bracing or stiffening, and can be used in longer sections than sheets made from other metals. Steel sheets also have more resistance to damage from denting or punching.

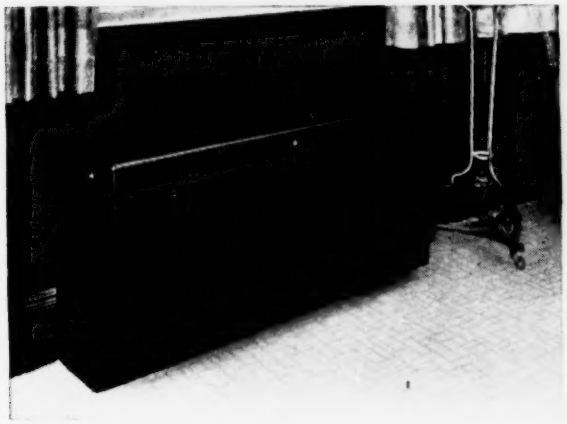
Bethlehem Galvanized Sheets are made of strong, durable steel, either plain or copper-bearing. Added to this steel is an adequate coating of zinc to guard against corrosion. This combination provides an economical long-lasting material for any kind of sheet-metal work.

When you consider the excellent quality, the low cost and the easy workability of Bethlehem Galvanized Sheets, you can see why they are in constant demand by sheet-metal contractors and fabricators.

Bethlehem GALVANIZED Steel Sheets

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation



Summer cooling... winter heating

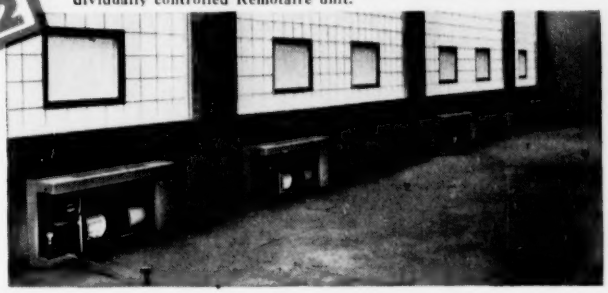
MODERNIZATION
made easy with
THE REMOTAIRE
an individual room, remote type unit providing year 'round air conditioning

1

Actual installation scene in large industrial office building showing arrangement of piping and ventilation aperture before placement of Remotaire units.

2

View of Remotaires with front covers removed. Large open area such as this can be partitioned into small offices, each with an individually controlled Remotaire unit.



3

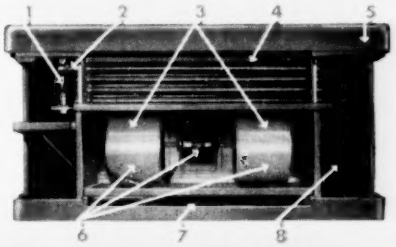
View of building showing ventilator apertures as they look from the street. Ventilation air can be supplied by several other methods, if desired.

THE Remotaire by American-Standard provides efficient, economical all-weather air conditioning for hotels, motels, apartments, schools, office and industrial buildings, and other types of multi-room installations.

The Remotaire is ideal for new construction as well as modernization. It uses chilled water from a central water chiller for cooling and warm water from a central heating plant for heating. Ventilation comes from a small wall aperture behind each unit, thus eliminating use of large, expensive, space-consuming ductwork. For descriptive literature, write for Form No. 298. **American Radiator & Standard Sanitary Corporation,** Dept., HV-112, Pittsburgh 30, Pa.

Designed for simplified economical installation . . .

1. Four standard control packages are available.
2. Coil designed for right or left hand connections. Easily reversed if necessary.
3. Exceptionally quiet fans and acoustically-treated air passages.
4. Coil shield over the top of coil prevents foreign matter from falling into coil.
5. Cabinet of reinforced furniture steel—plus a reinforced air grille—adds to permanence and long-lasting beauty of unit.
6. Fans and motor on single mounting plate permit easy removal if necessary.
7. Ventilation can be adjusted with the fresh air damper located in each unit.
8. Spacious end compartments provide easy installation and allow more than 90° horizontal wrench swing.



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HEATING-COOLING

Serving home and industry

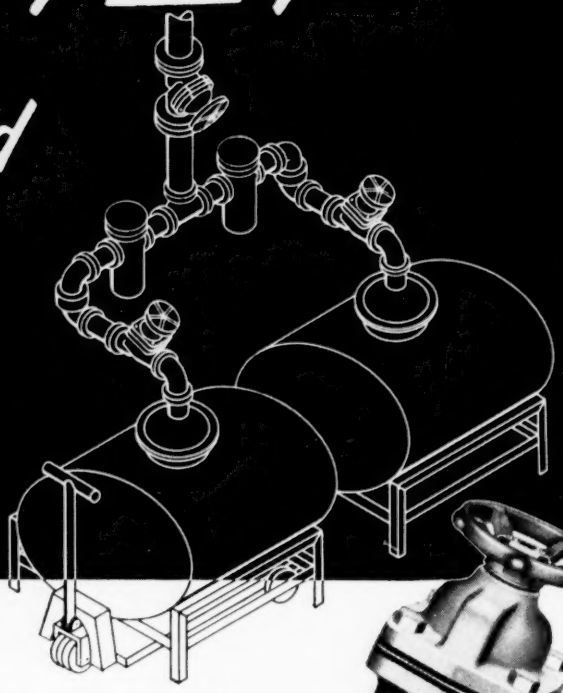
AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS

It's not what you Pay for Valves . . . it's what they Cost you

on Sticky Fluid

for instance

(A Case History)

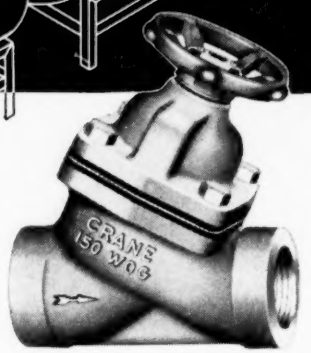


What you pay for valves is not the final criterion of value. Not when maintenance costs can quickly equal or exceed purchase price. And a valve that hinders production is no bargain at any price.

Take the case of valves formerly used on liquid latex lines in a paint factory—the Adams & Elting Division of the Glidden Company, Chicago. The valves were conventional design with working parts exposed to fluid. The sticky latex accumulated and congealed in the bonnet and stem threads. Too often, the valves were inoperable, forcing frequent costly maintenance with costlier production delays.

The trouble was stopped completely with Crane Diaphragm Valves. Their sealed-to-fluid bonnet keeps latex out of the working parts. They operate smoothly; never stick, never need cleaning out.

Today, more than ever, you need greater assurance of quality. You get it in Crane Valves—the recognized standard of quality with thrifty buyers in every industry. Your big Crane Catalog offers complete selections for all needs; your Crane Representative is always at your service.

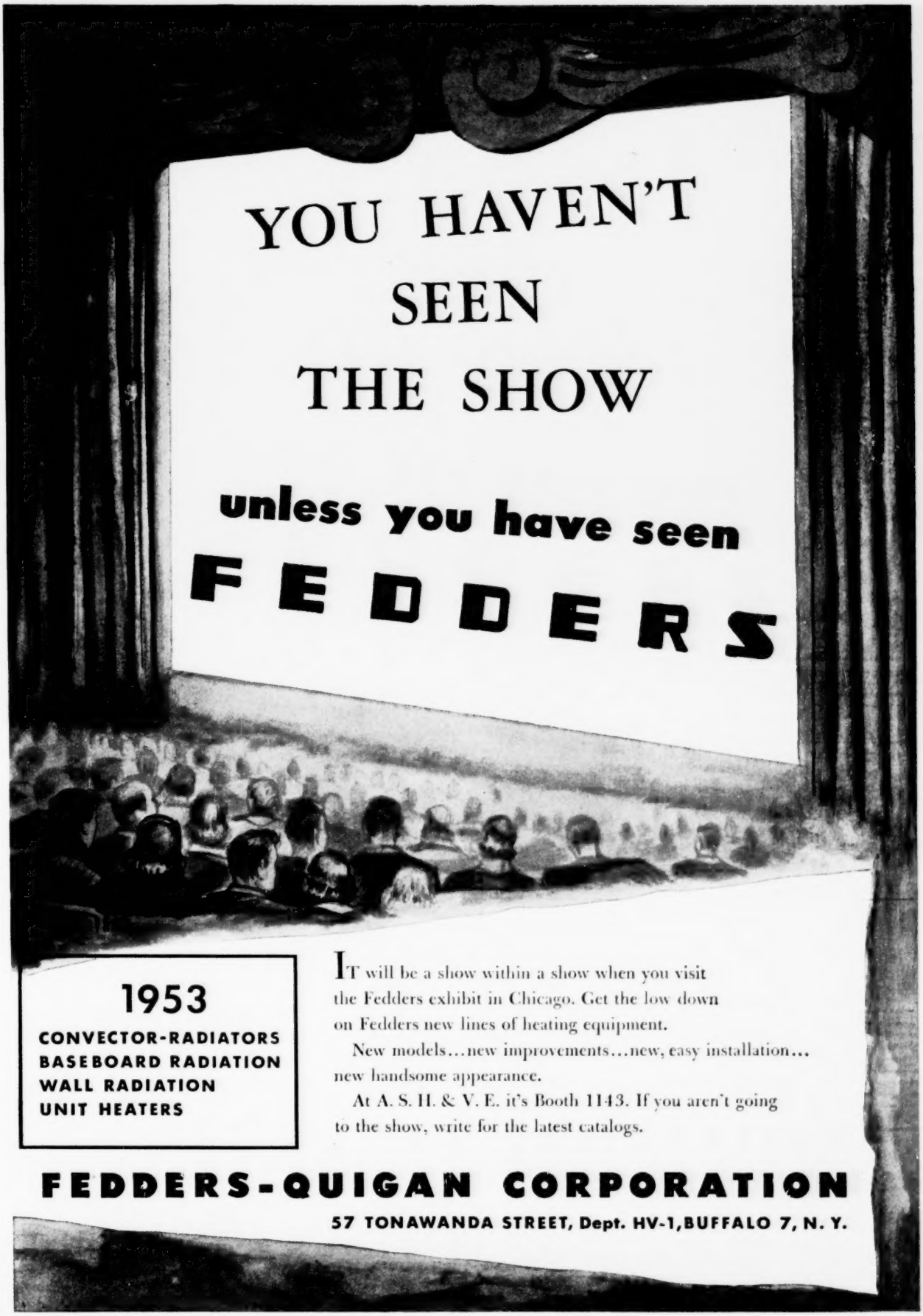


Crane Packless Diaphragm Valves, made with iron, brass, aluminum, or 18-8 Mo body, lined or unlined. See your Crane Catalog.

CRANE VALVES

Crane Co., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas.

VALVES • FITTINGS • PIPE • PLUMBING • HEATING



1953

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BASEBOARD RADIATION
WALL RADIATION
UNIT HEATERS

IT will be a show within a show when you visit the Fedders exhibit in Chicago. Get the low down on Fedders new lines of heating equipment.

New models...new improvements...new, easy installation... new handsome appearance.

At A. S. H. & V. E. it's Booth 1143. If you aren't going to the show, write for the latest catalogs.

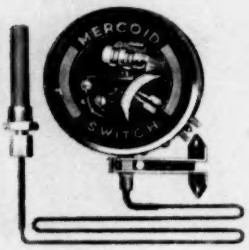
FEDDERS-QUIGAN CORPORATION

57 TONAWANDA STREET, Dept. HV-1, BUFFALO 7, N. Y.

MERCOID

AUTOMATIC CONTROLS

TEMPERATURE

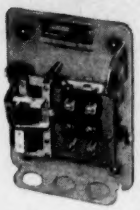


—60°F. to 750°F.

PRESSURE

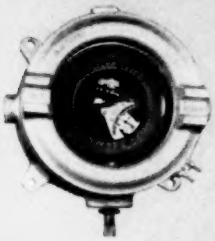
30" Vac. to 2500 P.S.I.

RELAYS



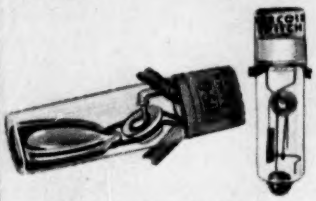
Single & Multiple Circuits

EXPLOSION-PROOF



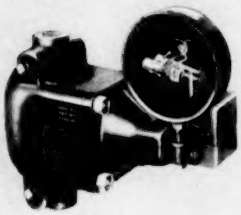
FOR EVERY TYPE OF APPLICATION

MERCURY SWITCHES



Tilting & Magnetic Types

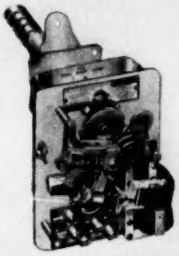
LIQUID LEVEL



Pressures to 400 lbs.

WEATHER-PROOF

FOR OIL BURNERS



Constant or Intermittent Ignition

If you have a problem involving the automatic control of pressure, temperature, liquid level, mechanical operations, etc., it will pay you to consult Mercoid's engineering staff—always at your service.

For illustrated catalog describing the entire line of Mercoid Controls write for Catalog No. 700A

THE MERCOID CORPORATION

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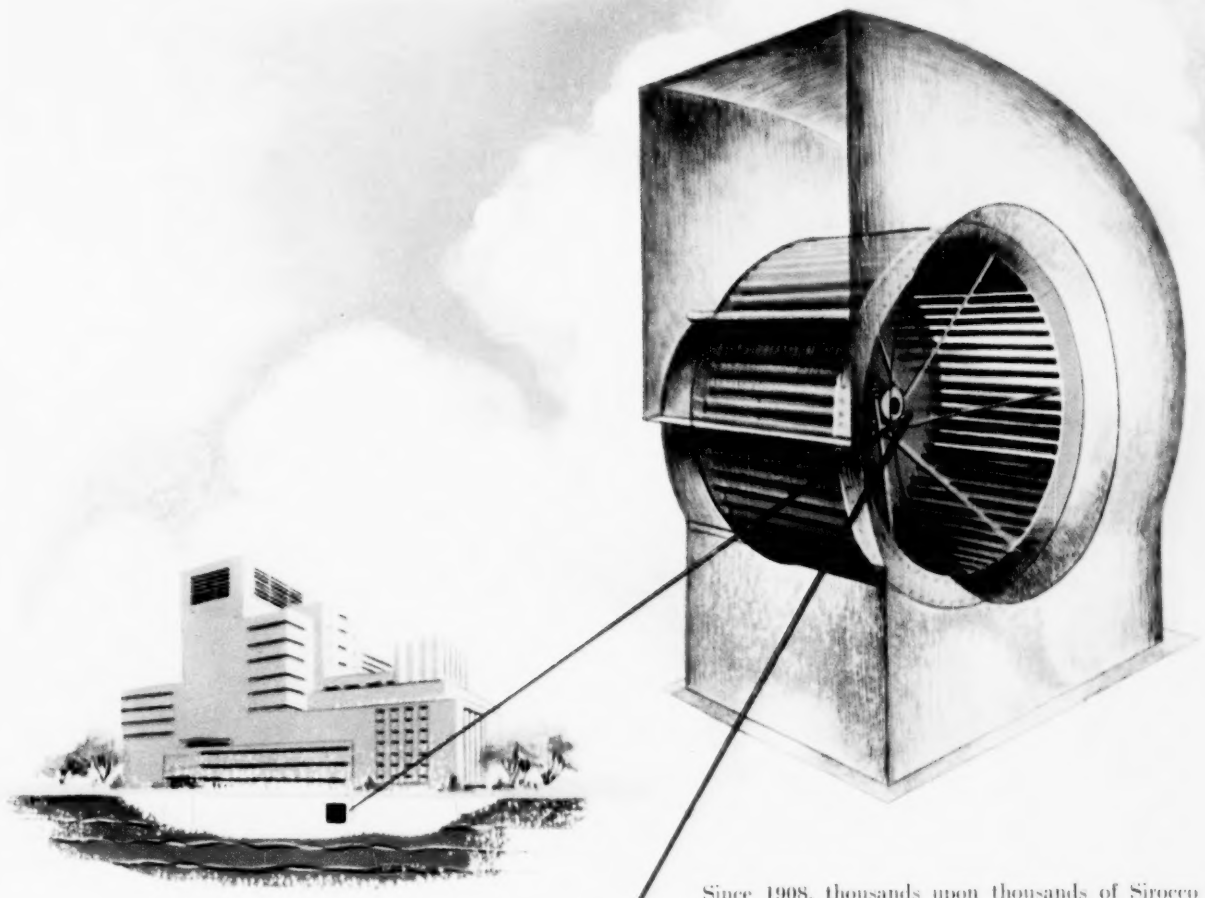
American Blower – a time-honored name in air handling



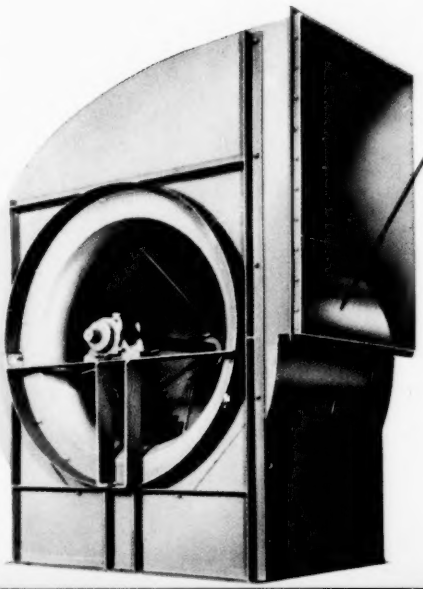
Since 1908, thousands upon thousands of Sirocco Fans have been installed throughout the world—in mechanical draft and industrial applications, in heating, drying, ventilating, air conditioning, fume removal and processing systems.

This unparalleled record in the field is due in part to these facts: The Sirocco Fan operates at lower speed, delivers more air per revolution than any other type fan, and, for a given duty, the Sirocco Fan occupies the minimum amount of space.

For data on how the Sirocco Fan can best be applied to your business, consult the nearest American Blower Branch Office.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary Corporation



American Blower Series 81 Sirocco Fan. All Sirocco Fan ratings are Certified in accordance with the Standard Test Code as adopted jointly by the NAFM and ASH&VE.

AMERICAN BLOWER

YOUR BEST BUY IN AIR HANDLING EQUIPMENT

Serving home and industry

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These are customers!

Sidewalk snow melting helps keep them

. . . and brings more

Sooner or later, *whatever* the business, a "buyers market" *will return.* When it does . . . and for some it already *has* . . . competition will again reign as "the life of trade."

It may then be that so little a thing as a friendly smile or a considerate way of dealing will react favorably. Certainly the *bigger* things like making it easy, convenient, and comfortable to transact business will help keep present customers and attract new ones.

So, for good business reasons many merchants, bankers, hotel, apartment and office building owners, and others are installing sidewalk and parking area snow melting systems. As *sales builders* such systems rank with air conditioning, good lighting and modern rest rooms.

You can be sure when you specify steel pipe, that it is the *first choice* for such installations. For steel pipe is economical, formable and weldable for coil and grid fabrication, and has been proved in more than 60 years of conventional hot water and steam heating applications. In fact, for snow melting and other applications, steel is the most widely used pipe in the world!

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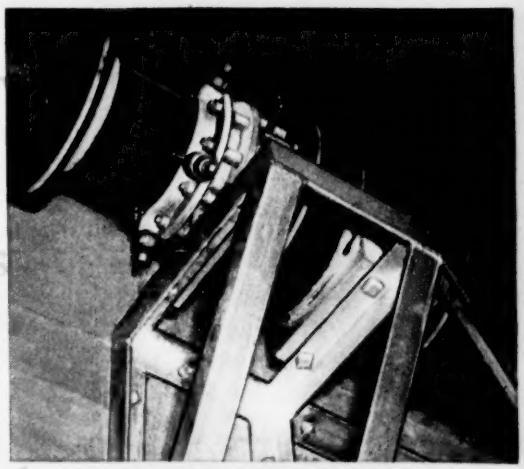
Central station heating plants, institutions and industrial plants all over the country are finding Gun-Pakt Joints offer *maximum protection* with *minimum maintenance*. Gun-Pakt Joints are *rugged, strong* joints. They offer freedom from shutdowns because they are *serviced under full steam pressure*. Maintenance costs are low; one utility that kept accurate records found their maintenance costs to be only 65c per year per joint!

To service a Gun-Pakt Joint you simply insert a plug of packing, twist a wrench, and the joint is tight . . . the job done . . . all without taking pressure off the line.

Yarway engineers, conveniently located near you, are constantly working for better, more profitable steam plant operation. Call on your Yarway man for friendly, helpful advice.



Yarway Gun-Pakt Expansion Joint installed in Rochester Gas & Electric Corporation's Broad St. subway line. 10" joint, 225 lbs. pressure, 450°F.

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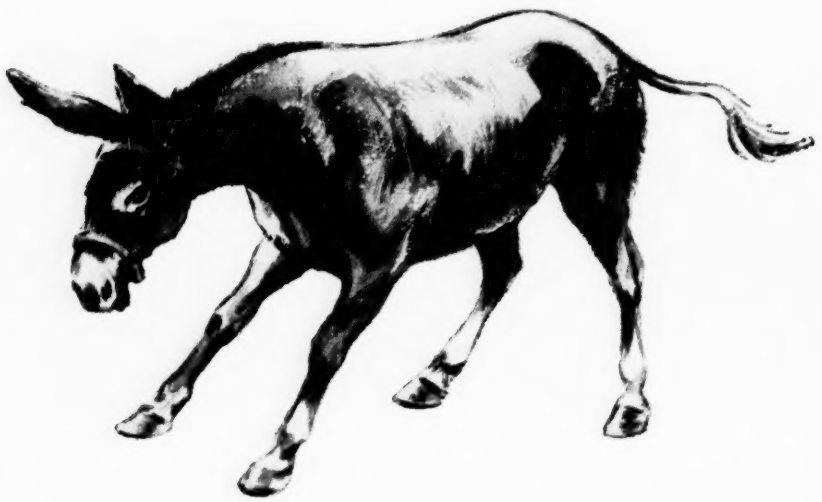

YES, in the modern coal mine there's no room for Jenny. Today her job is done by powerful electric locomotives capable of pulling 50 times the load Jenny used to haul to the mine surface.

As a matter of fact, in the modern mine even the traditional pick and shovel are as out-of-place as Jenny herself! More than 90% of *bituminous* coal is now mechanically cut, and over 70% is mechanically loaded. Result: more economical coal to light the way, fuel the fires, power the progress of America.

But, basically, what caused Jenny to disappear? What's behind American industry's evermore efficient machines that turn out goods at lower cost—thus making them available to more people? One word tells the story—COMPETITION.

In the coal industry there are 5,000 privately managed coal companies competing with one another and all competing in the market with other fuels. When one coal company develops more efficient mining methods, the rest can keep pace only by striving to improve even further. No wonder that with his modern machines, developed through competition, the American miner's daily output is 4 to 24 times that of any miner in Europe or Asia—most of whom work in government-controlled coal industries.

Just as competition spurs *you* on to trying harder—it's competition that goads the individual company to deliver products that will outsell others. And it's competition that keeps a whole industry on its toes, cutting distribution costs, opening up new outlets, and delivering better products.

Competition—not government control—has already made America the most productive nation on earth. Competition—not regimentation—points the way to ever greater plenty for all of us.

★ ★ ★

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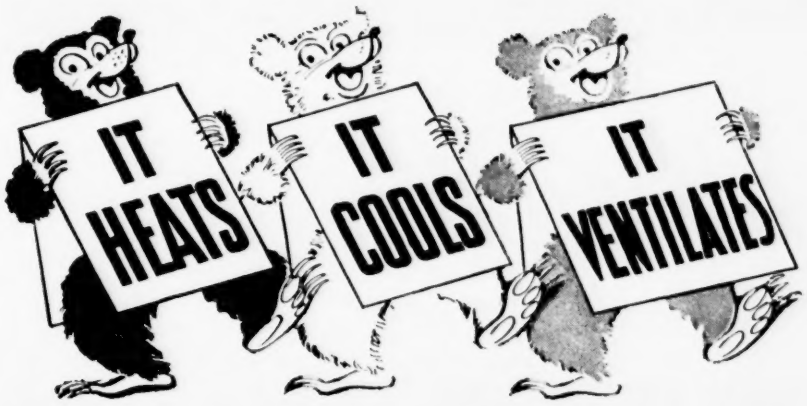
THE COMPETITIVE SYSTEM DELIVERS THE MOST TO THE GREATEST NUMBER OF PEOPLE



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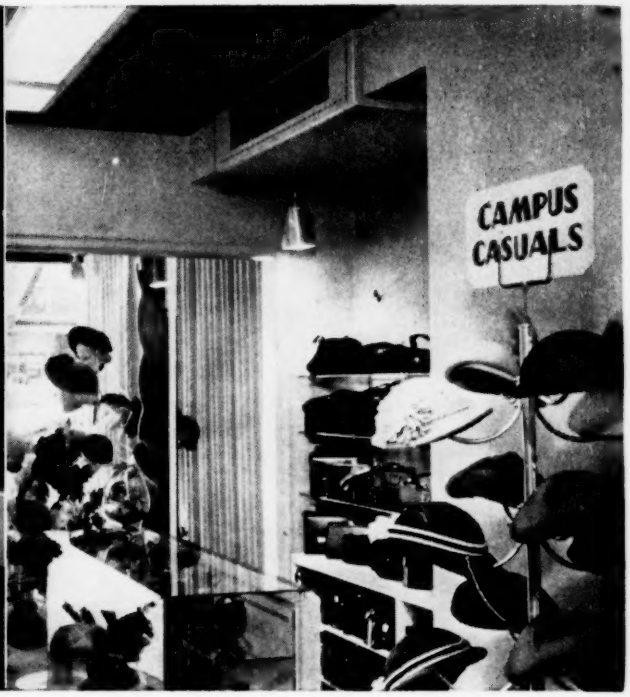

TYPE BT for heating, cooling (in floor-mounted position), ventilating, with or without ducts. Floor, wall or ceiling mounting.

IF you need economical equipment for heating, cooling and ventilating—and the expense of unit ventilators or air conditioners is not warranted—you'll find the perfect answer in Modine's newly expanded line of Cabinet Units.

Here, in a single unit, you can get quick, positive, quiet distribution of heated or cooled air . . . with or without ducts. Inexpensive accessories permit introduction, filtering, heating and distribution of fresh outside air for ventilation.

Whether it's new construction or modernization work—Modine Cabinet Units harmonize perfectly with any interior. You can choose from five different models—some for heating with steam or hot water only . . . others for heating plus cooling with chilled water.

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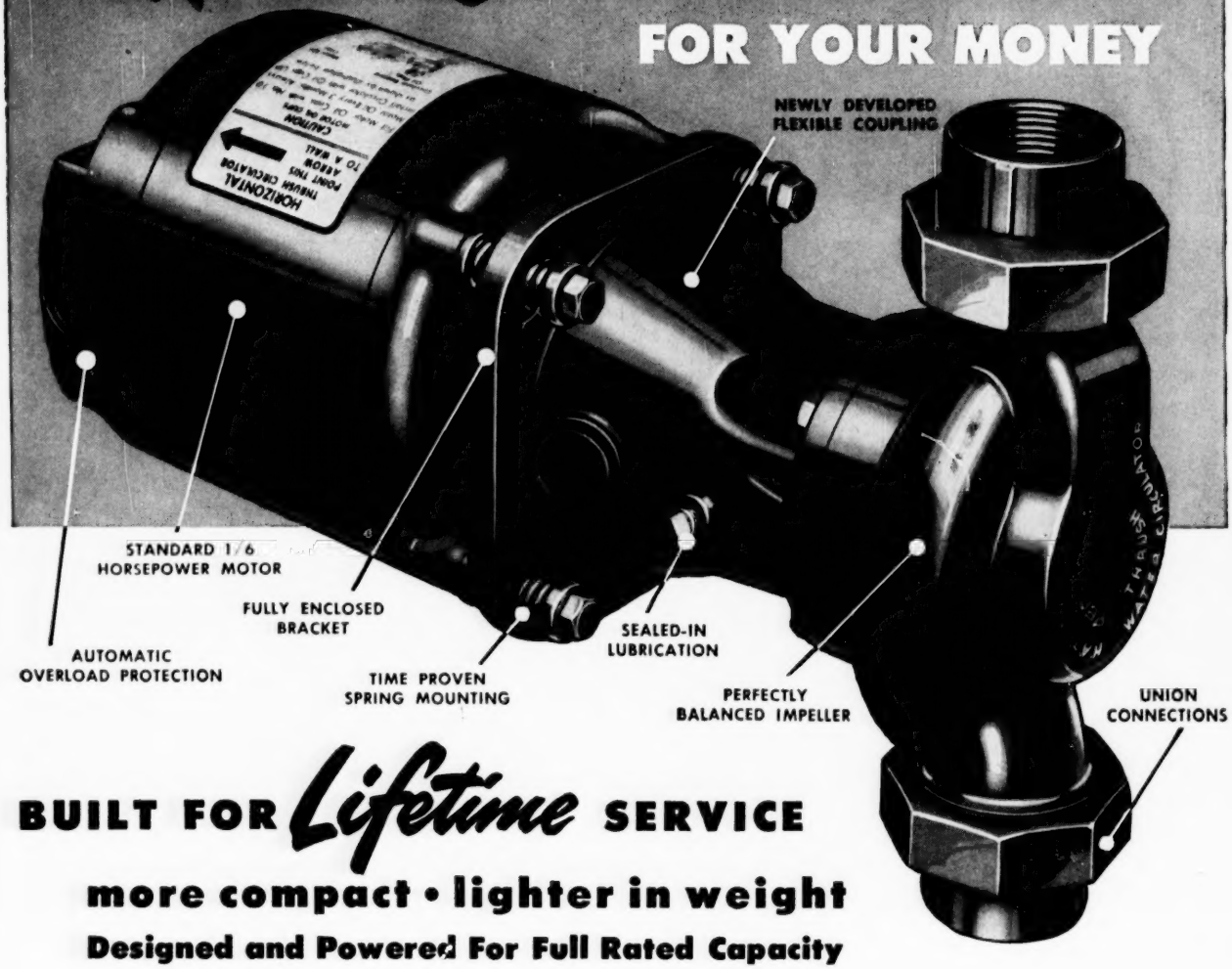

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BRIEFLY STATED

• At the organization meeting on November 13, in Newark, N. J., members of ASHVE residing in Northern New Jersey formed the North Jersey Chapter of the society. The members elected to office for the initial term to July 1, 1953 are: President, F. H. Faust, Bloomfield; Vice-President, H. M. Patrick, Bernardsville; Secretary, C. H. Smith, Linden; Treasurer, W. C. Kruse, Jr., Newark; Board of Governors, E. T. Best, Patterson; M. C. Christesen, Newark; and O. O. Oaks, Somerville.

• James F. Donnelly has been named vice-president in charge of sales for Servel, Inc., it has been announced. Mr. Donnelly, who also is president of GAMA, fills a vacancy caused earlier this year when John K. Knighton resigned. Previously, Mr. Donnelly held several executive posts, including that of assistant general manager, with A. O. Smith Corporation.

• Plans for a $900,000 expansion of the main plant of Minneapolis-Honeywell Regulator Company have been announced. Application had been made to government agencies for a certificate of necessity to construct a two-floor addition that will add 59,000 square feet of floor space to the present main plant building which, in addition to manufacturing operations, also houses the company's executive and administrative offices.

• The election of Frederick S. Blackall, Jr., president and treasurer of the Taft-Peirce Mfg. Co., Woonsocket, R. I., as president of ASME for 1953, was announced at the society's 73rd annual meeting in the Statler Hotel, New York. The new president succeeds Reginald J. S. Pigott, chief engineer of Gulf Research and Development Co., Pittsburgh, Pa.

• The Joint Industry Board of the Electrical Industry of New York City has voted unanimously to approve the use of powder-actuated fastening tools for the first time on all electrical jobs in that area, it was announced.

• Wagner Electric Corp., St. Louis, Mo., announced the appointments of: J. S. Smith as director of purchases and production planning; H. S. Garrett as purchasing agent with full responsibility for the administration of purchasing activities, with assistant purchasing agents J. V. Christman, M. W. Cox and E. B. Shanklin; and Fred Cheney as manager of inventory requirements.

• James A. Donnelly, a pioneer in certain phases of steam heating and a charter member and former treasurer of ASHVE, died November 8 at the age of 84. About the turn of the century Mr. Donnelly developed the postive differential system of steam circulation and from 1911 to 1919 was president of the Positive Differential Systems Company and later with the Donnelly Systems Company. He was the author of numerous papers on steam heating and pipe sizing and also lectured at Brooklyn Polytechnic Institute on these subjects. He is survived by two sons, Ralph, of Hancock, Md., and Webster, of Hartford, Conn.

• The first holder of the national NAMP four-year scholarship to the engineering school of Carnegie Institute of Technology, Louis Nielsen of Brooklyn, is now Senior Plumbing Engineer for the New York State Building Code Commission. Mr. Nielsen, who is the son of Peter Nielsen, a master plumber and contractor in Brooklyn for many years, graduated from Carnegie Tech in 1930. During the summer months of his school years, he worked at plumbing jobs designated by the scholarship committee of the national association. Since that time, he has been engaged as a professional engineer in various phases of plumbing and heating work. He has also been an instructor in plumbing subjects at the Delehanty Institute in New York City. Mr. Nielsen is a member of the American Public Health Association and of the American Society of Professional Engineers, and has been secretary of the Brooklyn and also the Greater New York Association of Master Plumbers. The scholarship funds were collected from master plumbers, materials manufacturers, and contractors, and only sons of master plumbers were eligible to compete. It was felt, when the fund was established in the 1920's, that these engineering school graduates could bring fresh blood into the plumbing industry.

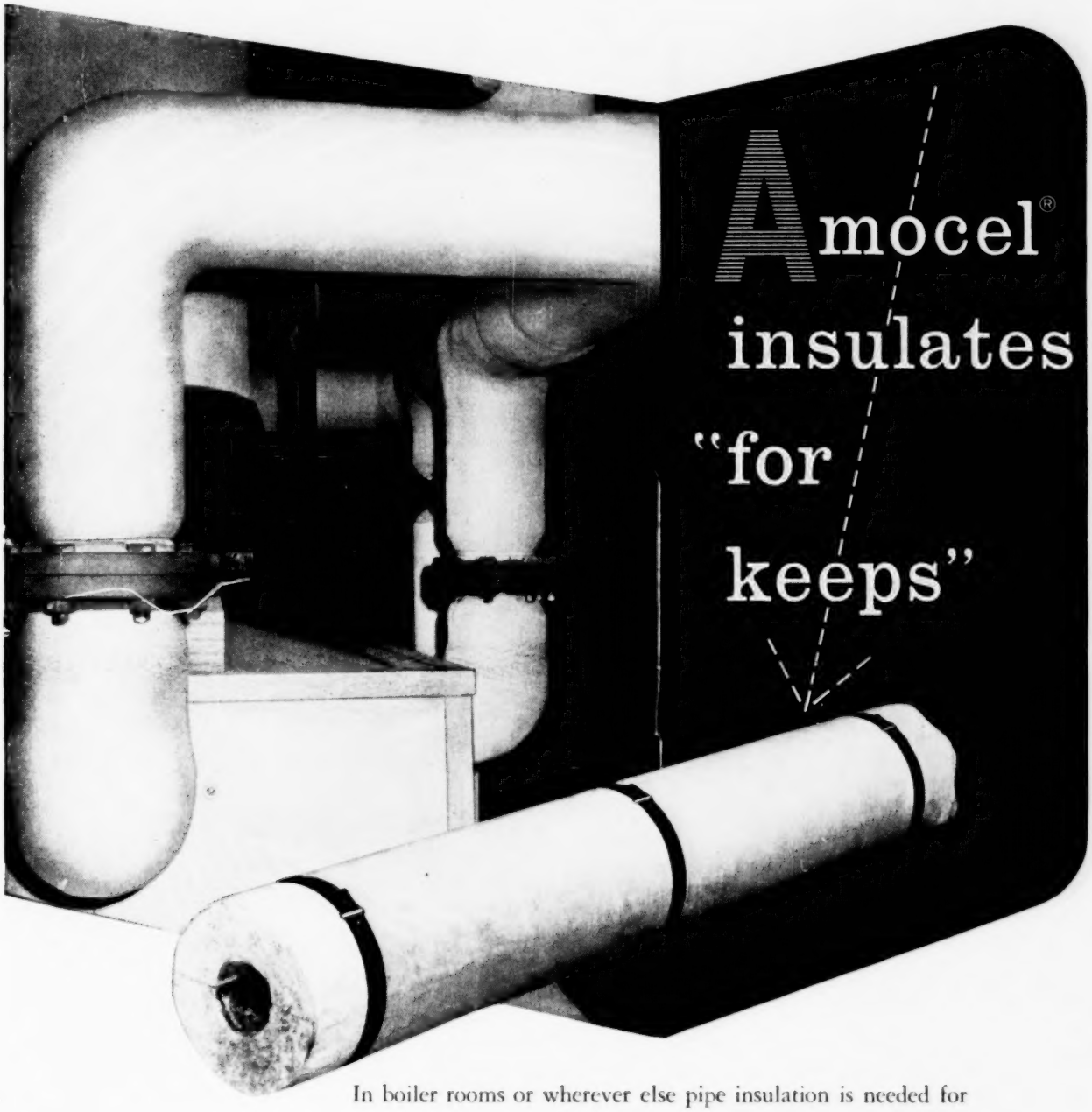
• Jacob Jarcho, one of the founders and vice-chairman of the board of Jarcho Bros., Inc., a large plumbing and heating contracting firm in Long Island City, N. Y., passed away November 24 at the age of 75. Mr. Jarcho served until his illness as chairman of the Arbitration Committee of the Association of Contracting Plumbers of the City of New York, Inc., the Apprenticeship Committee, and the Arbitration Committee of the Plumbing Industry Board of New York City. He leaves his wife, Ray, and his sons, Sidney, James, and Irving.

• David E. Feinberg has been named general manager of United States Air Conditioning Corp., Minneapolis, Minn., to succeed his father, A. A. Feinberg, who died on October 7. A vice-president of the corporation since May, 1951, Mr. Feinberg has also served as sales manager of the company's refrigeration division and as co-ordinator of its defense production activities.

• The appointment of E. H. Martin, Jr., as manager of Foamglas Insulation sales has been announced by Pittsburgh Corning Corp., Pittsburgh, Pa. Mr. Martin has been associated with the corporation since 1949 as assistant manager and manager of insulation sales.

• The Duriron Company, Inc., Dayton, Ohio, announces the appointment of R. A. Prosser as manager of building equipment sales. Mr. Prosser, who has been Chicago district manager since 1945, has moved to the home office in Dayton, to direct the sale of drain pipe and exhaust fans.

• John Hellstrom, vice-president of American Air Filter Co., Louisville, Ky., has been appointed director of sales. He returned from San Francisco, where he organized and managed the company's Pacific division, and assumed his new duties on the first of November, by which time the sales and advertising departments of the Herman Nelson Division, Moline, Ill., had moved to Louisville. Assisting him is Robert W. Nelson.



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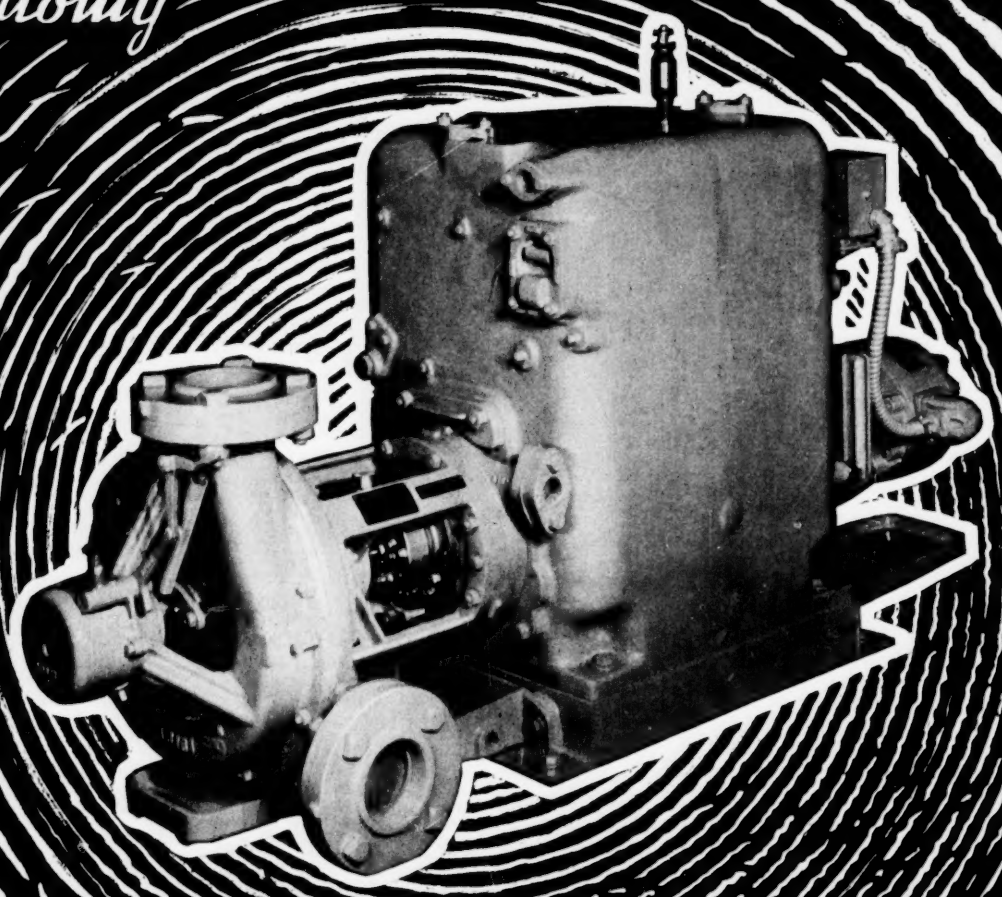

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More important, this pump insures absolutely uniform circulation in system. That means continuous steam economy.

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FLOW and FAN—

Principles of Moving Air Through Ducts

C. HAROLD BERRY
Gordon McKay Professor of Mechanical Engineering
Harvard University

This discussion will include the flow of air through duct systems, fan performance, and fan control. Elementary and advanced students as well as practicing engineers will find clearly stated principles of interest at the professional level. Based on a compilation of lecture notes, the matter has been arranged in a series of twelve articles, of which this is the first. In this issue, units and quantities used in flow calculations are defined and evaluated.

Part 1. Factors in Gas Flow Measurement

IN many engineering enterprises, we must establish and maintain the flow of air or other gas through a system of ducts by means of one or more fans, or by natural convection (natural draft). The fan must do work upon the air at a rate balancing the losses due to friction and other resistances. We must therefore consider the nature of the flow, the mode of variation of the resistances, means used for measuring quantities characterizing the flow, and certain theoretical relationships that simplify the problem.

This discussion presents a simple analysis of gas flow through ducts, intended to be applicable to ordinary engineering applications in which high precision is neither needed nor attainable, that is, to the usual run of problems arising in ventilating work. For more elaborate analysis of fluid flow, one must turn to texts in hydro—and aerodynamics.

Assumptions

The simple analysis to be developed is applicable to a restricted class of situations, with small departures from atmospheric pressure and temperature, that is, with small variations in the density of the flowing gas. It is hardly possible to define an exact boundary for this restricted region, but it may perhaps be defined in terms of the accuracy of the measuring instruments in common use. Undetectable discrepancies are negligible. So, if the job under consideration is one demanding high precision, the best available instruments will be used in checking the results, and the design computations must employ more refined methods. Simplifying assumptions must be confined to a narrow region. If, on the other hand, a low order of accuracy will be acceptable, and the results are to be checked with simple instruments used without extraordinary provisions for accuracy, then the design computations need not be so refined, and simplifying assumptions may be applied over a wider range.

The assumptions underlying this discussion are satisfactory for all ordinary ventilating undertakings, and for most boiler draft work, where the pressure within the duct is not more than one pound per square inch (27 inches of water) different from atmospheric pressure, and where high precision of result is neither needed nor confirmable by test methods of the usual sort.

It is assumed that the density of the gas is constant throughout the entire system. Much work in this field is in terms of so-called "standard air", density of which is 0.075 lb per cu ft = 3/40 lb per cu ft. In the absence of a statement of a different density, it is to be assumed that this density prevails. Several of the equations to be developed will appear in two forms, one embodying this numerical value of the density.

It is assumed that the gas velocity is uniform over any cross-section of the passage through which it flows. This clearly is not the truth. In any reasonably long duct, the gas velocity is high in the central portion of the duct, falls with increasing distance from the center, and falls rapidly

close to the walls. Accordingly, we must be careful how we use this assumption. It is used for working out general average results involving the duct area and the volume of gas flowing. It is not used when accurate measurements of volume flowing are to be made; in such cases we measure the velocity at numerous points systematically distributed over the cross-sectional area of the duct, so as to determine the flow pattern and to compute an accurate average velocity. For less exacting work, however, we assume uniform velocity. The simplification of computations is great, and the resulting error is acceptably small.

According to this assumption, at any point in the system,

$$M = \rho Q = \rho V A \text{ and } Q = V A \text{ and } V = \frac{Q}{A} \qquad (1)$$

where M = mass rate of flow, lb per sec or lb per min
ρ = gas density, lb per cu ft
Q = volume rate of flow, cu ft per sec, cfs, or cu ft per min, cfm
V = velocity, ft per sec, fps, or ft per min, fpm
A = area of duct cross-section, sq ft.

It must be remarked at once that we use both the second and the minute (and sometimes even the hour) and that one must be watchful to avoid confusion resulting from this unfortunate practice. In the more theoretical portions of the discussion we use the second: in equations intended for every-day use we use the minute.

Continuity

The principle of continuity asserts that in any continuous circuit the same mass of gas must flow through successive sections. The quantity $\rho V A$ must be constant from point to point along the stream. Since we have assumed that ρ is constant, it follows that V A must be constant; the velocity is inversely proportional to the cross-sectional area of the duct.

A more general statement is that the volume of gas flowing through any area intersecting the flow (at any angle such as a in Fig. 1) equals the area multiplied by the velocity component perpendicular to that area.

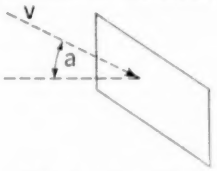


Fig. 1. Eq. (2).

$$Q = A V \cos a \qquad (2)$$

The principle of continuity is so simple and obvious that one often overlooks its great usefulness. Consider, for example, the problem of a paint spray booth in which a lacquer solvent evaporates, with a definite upper limit on the allowable concentration of solvent vapor in the atmosphere, because of health or explosion hazard. How much air must be exhausted from the booth? Suppose that the spray gun discharges 1 pound per minute of solvent, all of which evaporates, and suppose that the maximum tolerable concentration is 2 pounds of vapor per thousand cubic feet (these numbers are chosen for simplicity; they do not represent good practice). Clearly the exhaust must carry away vapor as rapidly as it is generated in the booth (otherwise the concentration would rise), and, moreover, the exhaust fan will pick up the booth atmosphere as it is, air and vapor together. Accordingly, the volume of air to be exhausted must be 500 cfm, since, with the stated concentration, that will carry off 1 pound of vapor per minute. Note that this is the final steady-state value; nothing is said about how rapidly the concentration builds up to this value, or what will be the concentration at the end of the first seven minutes. For transient-state values, more detailed study is required, but for the final steady-state value the equation of continuity is adequate to solve any problem of this nature.

Quantities Characterizing the Flowing Fluid

At any point in a flowing stream of fluid, there must be a definite *velocity*, V. We have already mentioned the relation between the rate of flow, the duct area, and the average velocity. Velocity defines the motion of the gas and determines its momentum rate and its kinetic energy per pound.

Likewise, at any point, there must be a definite value of the *pressure* sustained by the fluid (or, in equally good phraseology, exerted by the fluid). This is the pressure that (with temperature) determines the density of the fluid at the point in question. The pressure is the force per unit area pushing against the walls of the duct and tending to burst the duct. This pressure may be higher than atmospheric pressure, or lower. Most of our measuring instruments measure only the difference between the gas pressure within the duct and the atmospheric pressure without. This is called the gage pressure, and in ventilating practice it is often called by other names, such as vacuum, suction, draft, negative pressure (for pressures below atmospheric) and plenum, positive pressure, and even negative draft (for pressures above atmospheric). This somewhat confusing terminology is regrettable, but is too well established to be overlooked. In many cases confusion will be resolved by the reduction of all pressures to absolute pressures (measured above zero).

(abs. press. in duct) − (atmospheric press.) = (gage press. as indicated by instrument).

Atmospheric pressure at sea level is about 15 psi, 30 inches of mercury, or 408 inches of water.

The flowing gas has a definite *temperature* at any point in the stream. In the application contemplated in this study, temperature variations are usually small. In some cases the appearance of large temperature changes (as in heating and cooling apparatus) call for a more elaborate method of analysis, but in many cases even these large changes of temperature are neglected.

Our assumption of constant density is tantamount to assuming that the ratio of absolute pressure to absolute temperature is constant, since $\rho = p/RT$. But a rise in temperature in a heater is not accompanied by a proportional rise in pressure; our assumption is definitely contrary to fact, and in fussy work it is necessary to consider whether the resulting errors are acceptable. If they are too large, the method of computing must be elaborated.

Finally, at any point in a system, the fluid is at a definite *elevation* above datum.

Head

The concept of head has an important place in the mechanical analysis of fluid flow. We shall define it and then see what it means.

It is a quantity that combines in a single term the pressure, the velocity, and the elevation of unit mass of the fluid at any point in the flowing stream.

$$\text{Total head} = H_T = \frac{p}{\rho} + \frac{V^2}{2g} + z \qquad (3)$$

Where the only new symbols are

z = elevation above datum

g = acceleration of gravity

= 32.174 ft. per sec per sec

The terms making up the total head are known as the pressure head, the velocity head, and the elevation head, respectively.

It will be noted that each of these terms has the dimensions of length, and in the English system, head is expressed in feet of fluid. This is dimensionally equivalent to energy per unit mass, foot-pounds per pound of fluid. It is evident that the velocity head is the kinetic energy per pound, and the elevation head is the gravitational potential energy per pound. The pressure head may be thought of as potential energy due to the presence of the fluid in a region where the pressure p prevails.

The energy of a body in any state may be defined as the work required to carry the body to that state from a reference state in which the energy has an arbitrary value, often zero. The kinetic energy equals the work required to accelerate the body from zero velocity. The gravitational potential energy is the work required to lift the body from datum to elevation z. The potential energy due to pressure is the work required to introduce the body from an absolute vacuum into the region where the pressure is p. This equals the pressure multiplied by the volume of the body (the specific volume for a body of unit mass), or, for a body of unit mass, the pressure divided by the density.

It should perhaps be reiterated that while the total head can be interpreted in terms of energy, it includes only mechanical terms, excludes internal energy and thermal effects. The total head is the total mechanical energy of unit mass of fluid, but this is not its total energy.

Velocity head, kinetic energy, is always positive. Pressure head, if expressed in terms of absolute pressure, is always positive for a fluid, since, in ordinary situations, fluids cannot sustain tensile stress. If, however, pressure head is expressed in terms of gage pressure, it may be either positive or negative, since the fluid pressure may be above or below atmospheric pressure. Likewise, elevation head may be positive or negative, since the datum level may be so chosen that the fluid is sometimes above it, sometimes below it.

The Bernouilli equation asserts that, in any body of flowing fluid, in the absence of friction or other work effects, the total head is constant along any stream line.

$$\frac{p_1}{\rho} + \frac{V_1^2}{2g} + z_1 = \frac{p_2}{\rho} + \frac{V_2^2}{2g} + z_2 \qquad (4)$$

It further asserts that the dissipation of work through friction reduces the total head, that the receipt of work (as in a pump or fan) increases the total head, and that the expenditure of work (as in a water wheel) reduces the total head. That is, if work is expended or dissipated, the downstream total head will be less than the upstream value; if work is received, the downstream total head will be increased by that amount. The increase due to work receipt may be partially or wholly offset by the loss of work through frictional dissipation.

$$\frac{p_1}{\rho} + \frac{V_1^2}{2g} + z_1 = \frac{p_2}{\rho} + \frac{V_2^2}{2g} + z_2 + H_{L,1,2} + W_{x,1,2} - W_{r,1,2} \qquad (5)$$

where $H_{L,1,2}$ = loss of head (work dissipated) through friction between points 1 and 2

$W_{x,1,2}$ = work expended between points 1 and 2

$W_{r,1,2}$ = work received between points 1 and 2

The Bernouilli equation is the basis of ordinary hydraulic computations. It is applicable to the flow of any fluid so long as there is no significant change in the density of the fluid. A more complex equation, of wider applicability, is often called the Bernouilli equation. This need not concern us in this study.

Head × Density = Pressure: For some purposes, notably for the flow of gases, it is convenient to use the product of head and density.

$$\rho H_T = p + \frac{\rho V^2}{2g} + \rho z \qquad (6)$$

Each of these terms has the dimensions of pressure (e.g., psf), or energy per unit volume (e.g., foot-pounds per cubic foot).

ρH_T is called the *total pressure*, and is the aggregate mechanical energy of one cubic foot of fluid.

$\rho V^2/2g$ is called the *velocity pressure.*

ρz we shall call the *elevation term*, for want of a better name; it will shortly drop out of our consideration, so that no name is needed.

This leaves the term p, which is the prevailing fluid pressure, without a special name. To distinguish it from its companion terms, it is called the *static pressure.*

Various *symbols* are used. p_t, p_s, p_v are not wholly satisfactory due to their use for other concepts. Because of the derivation of these quantities from the respective hydraulic heads, the symbols h_t, h_s, h_v, h_z are perhaps as free from objection as any (one must not confuse them with enthalpy values, but this is unlikely, since thermal effects are not considered in this study). Some engineers prefer the symbols *TP*, *SP*, *VP*, but these look like algebraic products and may be confusing.

The Bernouilli equation may now be expressed in terms of pressures. In the absence of any machine transferring work to or from the fluid,

$$h_{t1} = h_{t2} + h_{L,1,2} \qquad (7)$$

$$h_{s1} + h_{v1} + h_{z1} = h_{s2} + h_{v2} + h_{z2} + h_{L,1,2} \qquad (8)$$

The introduction of terms to cover machines that transfer work to or from the fluid (pumps, fans, water wheels) will be deferred until we have considered other matters.

It is to be noted that it is the total pressure that remains constant, save for the decrease due to losses. Neglecting friction, the total head will be constant along a stream line. If the flow is such that the velocity pressure decreases (due to an enlargement of the duct area, which produces

a reduced velocity), the static pressure or the elevation term, or both of them, must increase in the same amount. With constant velocity, if the elevation term increases (by flow to a higher level), the static pressure must decrease in the same amount. Examples could be multiplied, but all are embodied in the statement that, save for losses (and for work transfers that we defer for later discussion), the total pressure remains constant along a stream line.

The pressure (static pressure), p or h_s is simply the pressure exerted on the walls of the duct, and can be measured by means of a pressure gage connected to a hole in the duct wall. Many precautions are necessary to secure a dependable reading. The most important of these concern the pressure hole (often called the pressure tap), which must be a small hole entirely free from burrs on its inner end, which must lie in a surface along which the fluid flows strictly tangentially, so that there are no velocity components along the axis of the hole (normal to the surface of the wall).

The velocity pressure is measured indirectly by bringing the gas to rest at the point of measurement. A so-called impact tube (Fig. 2) is inserted in the stream, facing against the flowing gas, and this is connected by suitable tubing to a pressure gage. If we take point 1 upstream of the impact tube, and point 2 just within the mouth of the impact tube, we may apply Bernouilli's equation. Between these two points there is virtually no friction loss, and at point 2 the velocity is zero, because the impact tube is connected to some kind of pressure gage through which there can be no flow. The two points are at or close to the same elevation, so that the elevation terms will cancel. Accordingly

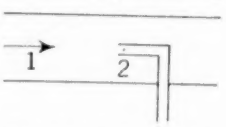


Fig. 2. Impact tube.

$$h_{t1} = h_{s1} + h_{v1} = h_{s2} \qquad (9)$$

Thus the pressure gage connected to the impact tube reads a pressure which equals the sum of the static pressure in the main duct plus the velocity pressure therein. If the static pressure in the duct is measured by a suitable gage, subtraction gives the velocity pressure in the duct.

The impact tube is an excellent instrument, in that it is insensitive to the details of its design and arrangement. It may be simply a length of pipe cut off with a hack saw. The end need not be cut exactly square, it need not be free from burrs. It need not point accurately in the direction of the gas flow: an angular departure of several degrees does not affect the reading. For many purposes the impact tube may be regarded as an almost perfect engineering instrument.

The impact tube and the static pressure tap are often combined in the Pitot tube (Fig. 3) sometimes called the Pitot-static tube. This is an instrument comprising two concentric tubes, joined in a faired end. The inner tube is the impact tube, and the outer tube picks up the static pressure through a group of very small holes drilled at some distance back from the point. Each tube is connected to a pressure gage, one reading the static pressure, the other the sum of static pressure and velocity pressure. A differential gage connected to both tubes will read the velocity pressure directly.

Fig. 3. Pitot tube.

As has been remarked, the impact tube is insensitive, but the static pressure holes of the Pitot tube do not share this advantage. The static pressure reading is rather sensitive to the orientation of the tube, which must be directed accurately into the gas flow. The holes must be carefully drilled normal to the tube surface, and must be free from burrs on their outer ends.

Many forms of Pitot tubes are in use, with various end shapes and various arrangements of the static pressure taps.

For reliable Pitot tube readings the duct flow must be free from spin and there must be no significant radial components of velocity (as in a tapering duct or in severely turbulent flow).

Spin can be eliminated by installing a straightener in the duct. This is often an "egg-crate", that is, a cellular structure of intersecting strips of thin sheet metal dividing the duct into square sections at intervals ranging from 5 to 7.5 percent of the duct diameter. The length of each cell should be three times its lateral dimension. (See ASME Test Code for Fans).

Sometimes egg-crates have been made of wood strips of stream-lined profile. For small ducts the straightener is sometimes a series of flat radial vanes welded to a small tube at the axis of the duct.

Units

In the English system the fundamental unit is the pound per square foot. In all computations of work, it is necessary to convert readings to this unit, as we shall see. No instrument reads pounds per square foot directly.

In the field of gas flow, the pressures differ but little from atmospheric, and a sensitive gage must be used to measure the difference. We almost always use a water manometer, so that in practice our readings are virtually always in inches of water.

1 inch of water = 5.19 psf (we often use 5.2)

The Influence of Elevation

Consider the atmosphere as a stationary body of gas having the density 0.075 lb per cu ft. What is the value of the elevation term $\rho z = h_z$ in inches of water? Density in pounds per cubic foot multiplied by elevation in feet will give the value in pounds per square foot, and this divided by 5.2 will give inches of water.

$$0.075\ z/5.2 = h_z \text{ in inches of water} \qquad (10)$$

At a point 70 ft above datum, $z = 70$, and the elevation term becomes

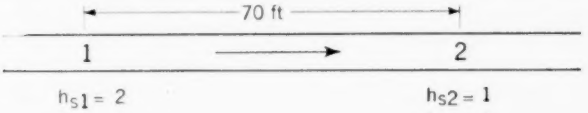
$$0.075 \times 70/5.2 = \text{about 1 inch of water} \qquad (11)$$

We have already noted that if the velocity is unchanged (in this case it is zero throughout), an increase in the elevation term must be accompanied by an equal decrease in the static pressure. h_s decreases as h_z increases.

The pressure of the atmosphere drops about 1 inch of water for a rise of 70 ft.

Now consider a horizontal duct through which gas is flowing. Take two points 70 ft apart in this duct. Let the

gas velocity be such that the velocity pressure h_v is 1 inch of water (the same at both points, since the duct area is unaltered and continuity therefore indicates unchanged velocity). The elevation is the same at both points, so the h_z terms will have the same value (which we shall call zero, that is, we shall take the duct elevation as datum). Let the flow be such that the static pressure at point 1 is 2 inches of water above atmospheric pressure. And finally let the loss between 1 and 2 be 1 inch of water, due to flow friction within the duct.



$h_{s1} = 2$		$h_{s2} = 1$
$h_{v1} = 1$		$h_{v2} = 1$
$h_{z1} = 0$		$h_{z2} = 0$
$h_{t1} = 3$	$h_{L,1,2} = 1$	$h_{t2} = 2$

Fig. 4. Loss of head in horizontal duct.

Bernouilli's equation gives the values indicated under Fig. 4.

$$h_{s1} + h_{v1} + h_{z1} = h_{s2} + h_{z2} + h_{v2} + h_{L,1,2} \qquad (12)$$

$$2 + 1 + 0 = 1 + 1 + 0 + 1$$

To foreshadow what we shall shortly be forced to do, let us rewrite the numerical equation in terms of absolute pressure. Atmospheric pressure being 408 inches of water,

$$410 + 1 + 0 = 409 + 1 + 0 + 1$$

The decrease in total pressure equals the intervening loss due to friction in the duct.

Now let us turn this duct so that the flow is vertically upward. This should produce no difference in the flow within the duct. The values at point 1 and the friction loss will be unaltered. There will appear a positive value for $h_{z2} = 1$ inch. Beside the sketch we have shown the numerical values. These involve a point that may be puzzling at first sight. The total pressure, measured above atmospheric, is the same at both points. Yet there has been a loss between the two points, which should appear as a decrease in total pressure. This is just the situation in which it is important to make use of absolute pressures. At point 1, where the atmospheric pressure is 408 inches of water, the absolute pressures are the same as when the duct was horizontal. The total pressure is 411 inches absolute, just as before. At point 2 the total pressure (absolute) is less than that at point 1 by the amount of intervening loss (1 inch), and is therefore 410 inches absolute. But at point 2 the atmospheric pressure is only 407 inches of water, so that the total pressure is 3 inches gage, that is, a gage connected to an impact tube will read 3 inches at this point. The velocity pressure at point 2 is still 1 inch of water, and the elevation term h_z equals 1 inch, as computed above for an elevation of 70 feet above datum. Accordingly, the static pressure at point 2 must be 408 inches absolute, which is 1 inch gage.

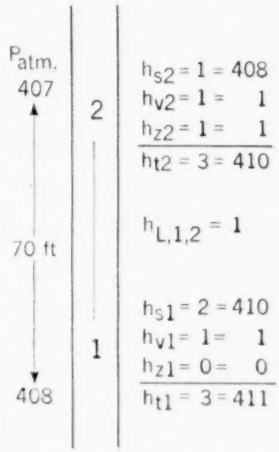


Fig. 5. Loss of head in vertical duct.

If we write Bernouilli's equation in terms of absolute pressures, everything checks nicely.

$$410 + 1 + 0 = 408 + 1 + 1 + 1$$

But if we write Bernouilli's equation in terms of gage pressures, things do not check.

$$2 + 1 + 0 = 1 + 1 + 1 + 1$$

What is wrong? In the vertical case, as we pass upward in the duct, two influences are at work. Friction is reducing the static pressure of the gas (velocity being constant), and also gravity is reducing the static pressure, as it does in any body of fluid, moving or stationary. From the gage pressures, it appears that the static pressure has dropped from 2 to 1, a drop of 1 inch of water, but this is not correct. The absolute pressures indicate that h_s has dropped from 410 to 408, a drop of 2 inches of water. We may observe that this drop is made up of two parts, 1 inch drop due to friction, and 1 inch drop due to gravity (elevation).

We have no trouble with Bernouilli's equation so long as we use absolute pressures. We do have trouble when we use gage pressures. The conclusion might be that we should always use absolute pressures. In many ways this would be an excellent custom, but in fact it is not the custom. We use another device that simplifies our computations at the expense of a danger that we shall mention.

We drop the h_z terms from the Bernouilli equation, and use gage pressures.

This, it will be seen, makes the equation fail to check in terms of absolute pressures, but it makes it check in terms of gage pressures.

$$2 + 1 = 1 + 1 + 1$$

Now the drop in static pressure appears to be 1 inch of water, and this is the drop due to friction. The pressure drop due to rising elevation has been omitted in two compensating ways (a) by neglecting the change in atmospheric pressure as it affects absolute static pressure, and (b) by omitting the elevation terms.

In symbolic form, Bernouilli's equation thus becomes

$$h_{s1} + h_{v1} = h_{s2} + h_{v2} + h_{L,1,2} \qquad (13)$$

and, correspondingly, the definition of total pressure loses its elevation term, and becomes

$$h_t = h_s + h_v \qquad (14)$$

This device gives us Bernouilli's equation in a form in which the substitution of gage pressures gives correct results for either of two situations:

(a) Ducts horizontal or nearly so, carrying any gas, of whatever density.

(b) Ducts of any configuration carrying a gas of a density approximately that of the atmosphere surrounding the duct system.

For other situations, this modified Bernouilli equation is definitely incorrect, and will give anomalous results, which may be very perplexing.

We may avoid confusion by adhering to a rigid rule of action: Whenever the duct system shows significant variations in elevation, and carries a gas of density

materially different from that of the surrounding atmosphere, always use the complete Bernouilli equation (including the h_z terms), and express static pressure in absolute pressure, by adding the gage reading to the atmospheric pressure at the elevation of the point in the duct at which each static pressure is measured.

This rule of action will also be helpful in cases in which the static pressure within the duct is below atmospheric pressure, so that the gage pressure is negative.

Atmospheric Pressure

The atmospheric pressure at various elevations is readily computed. At the level of the barometer the atmospheric pressure is measured, and the barometer reading, in inches of mercury is multiplied by 13.61 to give the atmospheric pressure in inches of water, or at some elevation it may arbitrarily be assumed that atmospheric pressure is 408 (or any other number) inches of water. Above this level, the atmospheric pressure will be less; below, it will be greater by an amount computed as the product of the vertical interval, in feet, times the density of the atmosphere (to be computed), divided by 5.2 (or 5.19) to give inches of water.

In the foregoing rule of action there are two indefinite words, "significant" and "materially". Just what these mean can be interpreted only in terms of the accuracy required or attainable in the job under consideration.

Having discussed this situation in terms of a numerical example, we may profitably work it out in general terms. If we understand h_s to denote the static pressure, as measured by a gage, then the absolute static pressure at any point is $(h_s + h_A)$ where h_A is the atmospheric pressure at the elevation of the point considered.

Bernouilli's equation, in absolute pressures, is then

$$h_{s1} + h_{A1} + h_{v1} + h_{z1} = h_{s2} + h_{A2} + h_{v2} + h_{z2} + h_{L\,1.2} \qquad (15)$$

Taking out the terms in which we are now interested,

$$h_{A2} - h_{A1} = -(z_2 - z_1)\ \rho_A / 5.2 \qquad (16)$$

Note the minus sign before the second member: atmospheric pressure is less at higher elevation.

$$h_{z2} - h_{z1} = (z_2 - z_1)\ \rho_G / 5.2 \qquad (17)$$

ρ_A is the density of the atmosphere. ρ_G is the density of the gas flowing within the duct.

Adding the two last equations,

$$(h_{A2} + h_{z2}) - (h_{A1} + h_{z1}) = (z_2 - z_1)\ (\rho_G - \rho_A) / 5.2 \qquad (18)$$

Whence we see at once that if either

(a) $z_2 = z_1$ whatever the densities, or

(b) $\rho_G = \rho_A$ whatever the elevations,

then the two terms in the first member will be equal, and may both be omitted from the Bernouilli equation. Otherwise these two terms will not be equal, and cannot be omitted. Note that h_A and h_z must be included or omitted together. The inclusion of one without the other will be wrong in any case.

When the fluid is water, density of which is 800 times that of air, $(h_{z2} - h_{z1})$ is 800 times $(h_{A2} - h_{A1})$, and the latter is customarily dropped in hydraulic computations. In the study of gas flow, on the contrary, the two terms of the same order of magnitude, and their difference may well be important. It must be remembered that in gas flow we measure pressure differences in inches of water, frequently to hundreths, sometimes to thousandths. This is an extremely small unit of pressure. Atmospheric pressure varies one thousandth of an inch of water for a difference in elevation of less than 7/8 inch, and one hundredth for a little over 8 inches. So, in the study of gas flow, seemingly small items may be significant.

Boiler Draft

Draft at any point in a boiler setting is defined as the difference between the absolute gas pressure within the setting and the absolute pressure of the atmosphere outside the setting at the same elevation. This definition will be more obvious if we consider: *What does a draft gage indicate?*

Draft gages, often reading to 0.01 inch of water, are commonly located together at a convenient location, but are connected to the boiler setting at various points above and below the gage board as shown in Fig. 6. A gage may be above or below the point of connection or may be connected differentially to two points, with no open communication with the atmosphere outside the boiler setting.

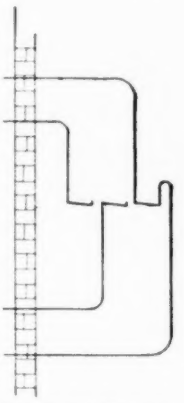


Fig. 6. Draft gages.

What do these gages indicate?

To answer this question we must first consider several details. The end of the draft gage tube within the boiler setting is fitted with a so-called static pressure tip which presumably is insensitive to gas velocity. So we may conclude that, whatever else may be said, the gage responds to the static pressure of the gas within the boiler setting.

But the gage is open to the atmosphere at a level different from the level of its connection to the setting. Between the connection and the gage there is a difference in atmospheric pressure that may be large in the case of a tall setting. On the other hand, between the connection and the gage there is a column of some kind of gas inside the connecting tubing. What is in the tubing? Air, not flue gas. How do we know that? Simply because we must from time to time make sure that the gage tubing is free from obstructions, and this is commonly done by opening a side cock near the gage and blowing air through the tubing. When the cock is closed and the gage is reconnected there is no flow in the tubing, so this air stays there. The next question is, what is the density of the air within the tubing. Its pressure will differ from atmospheric pressure, but usually only a little, perhaps no more than 10 inches of water, often much less. The pressure of the atmosphere being of the order of 400 inches of water, this departure is small. The temperature of the air within the tubing will probably not differ greatly from the temperature of the surrounding atmosphere. Gage tubing is usually carried away from the warm wall of the boiler setting as directly as possible, and often comes up or down to the gage board along the web of a nearby steel column.

To the extent that these assumptions are reliable, then, we may say that within the tubing there is air at substantially the pressure and temperature of the surrounding atmosphere, and hence having the same density as the surrounding atmosphere. If this be true, the gage is subject to outside atmospheric pressure differing from that at the level of its connection, but it is also subject to pressure through the tubing that differs from the gas pressure at its connection in the same way and to the same extent. Accordingly, the gage will read the draft at its point of connection to the setting, regardless of where the gage is located. Moreover, a draft gage connected differentially between two points in the setting will read the difference between the *drafts* at the two points, not, as might be guessed, the difference between the absolute pressures of the gas.

Effect of Density

When a vertical duct contains gas of density significantly different from that of the atmosphere, pressure differences develop even in the absence of flow. Consider the simple case of a tall vessel closed at the bottom filled with a light gas, such as hydrogen. At the open top the static pressure will be the same inside and outside. Passing downward from the top we find the static pressure increasing at a rate depending upon the density of the gas and the change in elevation.

$$\triangle p = - \rho \triangle z$$

(The minus sign indicates that as elevation decreases, pressure increases.) The density of the outside air is 0.075 and that of the inside hydrogen is 0.0052 lb per cu ft. Accordingly, if we consider a point 100 ft below the open top, we shall find that the outside atmospheric pressure will increase by 7.5 psf while the inside hydrogen pressure will rise by only 0.52 psf. At this level the gas pressure within the vessel will be less than the outside atmospheric pressure by 7.0 psf, or about 36 inches of water. If we should punch a hole in the vessel, vigorous flow would ensue and the hydrogen would be driven out through the open top of the vessel. The static draft at the top of the vessel is zero, at the bottom it is 36 inches of water.

In a less extreme way this is the situation in a boiler setting. The gas within the setting may have a density approximating half that of the outside atmosphere. The setting is open and flow prevails, but the hot gas is constantly renewed at the point of entrance so that a steady state is reached in which the pressure differences balance the frictional resistances, which vary with velocity and density.

Notwithstanding this flow, the static condition helps us to understand seemingly discordant draft gage readings. The draft at the top of the chimney is zero. In a natural draft installation an important function of the chimney is to connect the furnace to a place where the atmospheric pressure is sufficiently reduced to provide a pressure difference adequate to sustain the maximum desired rate of flow. A damper is used to increase the resistance of the path when reduced flow is desired.

At points below the top of the chimney a draft gage will give readings that increase as we pass to lower levels. As we go downward, draft tends to increase. As we go upward, draft tends to decrease. With gas flowing, these changes in draft may be offset or augmented by the loss of head in the flow stream or by changes in the velocity pressure. For example, if the gas is flowing upward there is a frictional drop that tends to lower the absolute pressure, i.e. to increase the draft at the higher level. If, on the contrary, the gas is flowing downward (as in a down pass in a boiler) the friction drop tends to increase the draft at the lower level. Whether the change in static draft predominates or is more than offset by frictional resistance depends upon the local situation; sometimes it is one way, sometimes the other.

In a boiler setting in which there is upward flow of gas, the gages often show that gas is flowing from a point of large draft toward a point of small draft, and a hasty interpretation takes this to indicate flow from low absolute pressure toward higher absolute pressure. This seems impossible; it is (except for changes in velocity not likely to occur in a boiler setting). Draft is the difference between gas pressure and atmospheric pressure at the same level. At the high point the atmospheric pressure is low and the draft is small, at the low point the atmospheric pressure is high and the draft is large. Thus at the low point the absolute pressure of the gas may be higher than it is at the high point, entirely consistent with upward flow.

Confusing and seemingly impossible draft gage data may often be brought into complete consistency by the simple expedient of reducing them all to absolute gas pressures, by subtracting each draft gage reading from the atmospheric pressure corrected to the elevation of the draft gage tip in the flue-gas stream.

The correction of atmospheric pressure is made by multiplying the elevation above a convenient datum by the density of the atmosphere computed from the ideal gas equation:

$$\rho = \frac{p}{RT}$$

where p is the barometric pressure, T is the ordinary Fahrenheit temperature plus 460, ρ is the density in pounds per cubic foot, and R is the gas constant which is, for air, 0.3704 if the pressure is in pounds per square inch and 0.7542 if the pressure is in inches of mercury. Then the difference in atmospheric pressure over a vertical interval of $\triangle z$ feet is

$$\triangle p = - \frac{\rho \triangle z}{5.19} \text{ inches of water}$$

It is convenient to assume that at some datum level the atmospheric pressure is 400 inches of water, and to add and subtract the corrections for lower and higher levels. Of course it is more precise to convert the barometric pressure in inches of mercury to inches of water (by multiplying by 13.61), but this is hardly necessary. So long as we compute the differences properly, it makes little difference whether the atmospheric pressure at the datum level is 390 or 415 inches of water; 400 simplifies the arithmetic a bit.

Next month, the author will discuss the computation of head, friction losses, and the Reynolds number.

Radiant Glass Heating Panels

PAUL R. ACHENBACH

National Bureau of Standards

Results of tests conducted at the National Bureau of Standards are discussed with particular attention to heat losses, temperature variations and gradients, and the power demands and lags observed when a test bungalow was heated by means of radiant glass heating panels. The outside conditions were varied, and tests were made with the bungalow both insulated and uninsulated.

IN recent years radiant glass heating panels have come into increasing use for heating residences and other small buildings. Therefore, at the request of the Housing and Home Finance Agency, under Title II of the Housing Act of 1948, glass heating panels were evaluated under various conditions of use by the Heating and Air Conditioning Section of the National Bureau of Standards under the direction of the author.

Typical Panel Tested

The typical glass panel tested was mounted on a metal frame and backed by a reflective shield separated from it by a small air space. A metallic coating on the rear surface of the glass served as the electrical conductor and heating element. The typical output of such a panel is about 1,000 watts, although units with lower wattage ratings are available from some manufacturers. Some panels are designed for 230 volts, others for 115 volts AC. Panels are made in sizes for mounting beneath windows, as baseboard units, or as vertical units adjacent to window frames. A panel design is illustrated in Fig. 1.

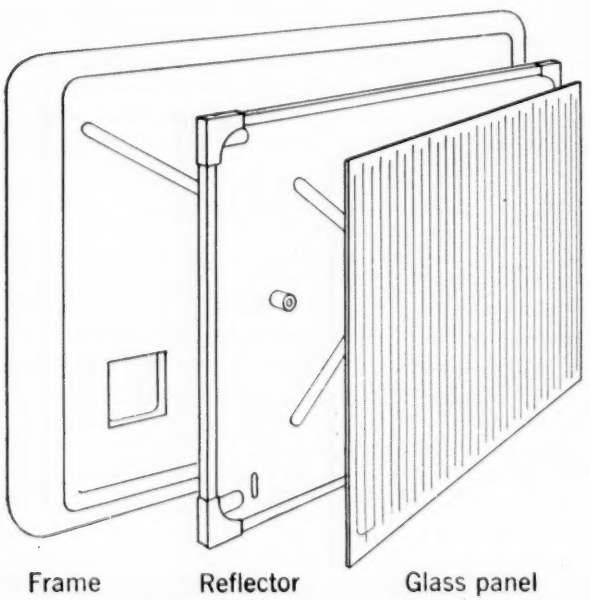


Fig. 1. Cross-section of typical glass panel.

Heat is transmitted from glass heating panels primarily by radiation and convection. When the panel is heated above the temperature of the air in the room, heated air passes upward over the face of the panel, through the space between the glass and the reflective shield, and between the shield and the frame of the panel assembly. At the same time, radiant heat is emitted outward from the face of the panel. The passage of air through the spaces back of the glass keeps the temperature of the rear of the assembly cool enough to allow it to be in contact with combustible materials.

Test Bungalow

The tests were conducted in the test bungalow, a small one-story house of four rooms and bath, as shown in Fig. 2. It had an unfinished attic and a full basement, but for the purposes of these tests was treated as a basementless house. The bungalow was completely enclosed in an insulated structure, with an open space of about 5 ft between the outer walls of the bungalow and the inner walls of the insulated shell. Unit coolers in the space around the bungalow provided the means for maintaining the desired outdoor temperature.

For some of the tests, the bungalow was insulated with $3\frac{3}{8}$ inches of rock wool laid on the upper side of the

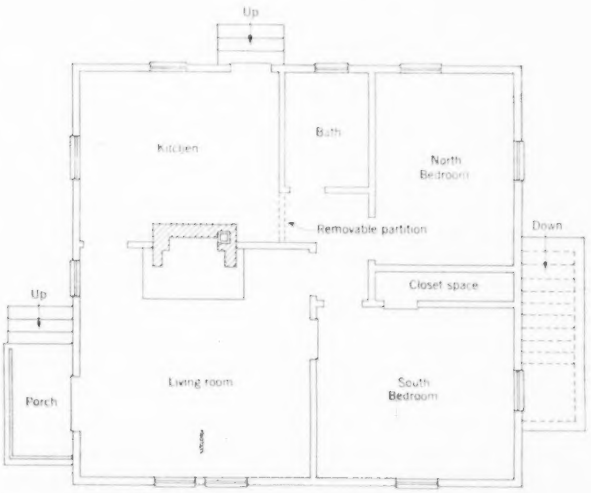


Fig. 2. Floor plan of test bungalow.

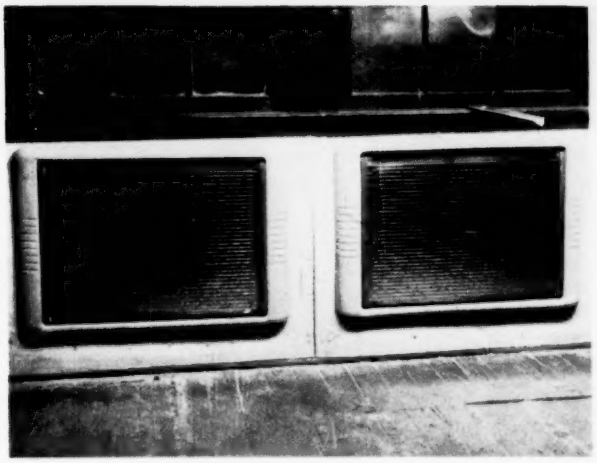


Fig. 3. Two glass panels under living room double window were mounted together. Other installations used single panels.

ceiling, one inch of rigid fiberboard nailed to the bottom of the floor joists, and weather-stripping on the windows and doors. The bungalow with this amount of insulation will be referred to as being uninsulated. For the remainder of the tests, the stud spaces of the walls of the bungalow were filled with expanded-mica insulation and plastic-filled, wire-mesh screen cloth was tacked over the outside of the window frames to simulate storm windows. With this additional insulation, the house will be referred to as being insulated.

Ten radiant glass heating panels were installed in the test bungalow at the beginning of the tests. Two of these were placed under the double window of the living room as illustrated in Fig. 3. One panel was placed under each of the other windows of the bungalow, making a total of three panels in the living room, two in the kitchen, two in each bedroom, and one in the bathroom, all located just above floor level. The panels were rated at 1,000 watts each at 230 volts, but were actually operated on a 208-volt power supply corresponding to a capacity of approximately 820 watts each. The panels in each room were connected on separate electrical circuits and the room temperature of each room was controlled by an individual thermostat and relay.

The initial power demand for the panels was about 145% of the steady demand after the panels had become thoroughly heated. Approximately 20 minutes were required after starting to attain steady power demand, while approximately 30 minutes were required to attain a steady temperature on the exposed glass surface. The temperatures at the centers of the glass plates, operating at rated voltage, averaged about 340F.

Temperature Differences

The graph in Fig. 4 shows the vertical temperature differences occurring in the house when the outdoor temperature was held constant at various levels in the range 0 to 32F. It is seen that the temperature differences in the living zone (2 to 60 inches above the floor) were moderately low, the maximum observed being 6.8F. At the maximum indoor-outdoor temperature difference, the gradient was 1.4F per ft of height in the living zone. At the minimum observed indoor-outdoor temperature differ-

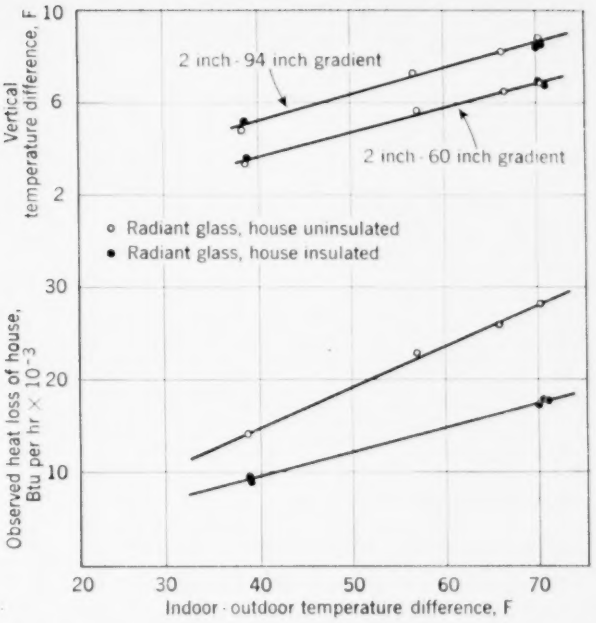


Fig. 4. Test temperature differences and heat losses compared.

ence of 38F, the gradient was 0.7F per ft of height. Taking the gradient from the floor to the ceiling resulted in values of 1.1F per ft and 0.6F per ft for the maximum and minimum observed indoor-outdoor temperature differences, respectively.

Insulating the walls and adding storm windows did not significantly change the vertical temperature differences observed in this house. This result was surprising since it had been expected that the vertical temperature difference would be approximately proportional to the heat loss for a given house and a particular heating system. Since the same number of panels were in operation in the insulated and uninsulated condition of the house, the percent of time during which the heaters were energized was appreciably less in the insulated house. Consequently, the chimney effect of the house and natural convection played a more significant role in the insulated house during the longer periods when the heaters were not energized than in the uninsulated house.

The maximum horizontal temperature difference between rooms was fairly small, averaging 2.5F. Insulation had no significant effect upon these variations.

As shown in Fig. 4, it was found that the steady-state heat losses of the bungalow at 0F outside temperature, were 28,000 Btu per hr and 17,700 Btu per hr for uninsulated and insulated conditions, respectively. Converted to the corresponding units of electrical power, these values are equivalent to 8.33 kw and 5.18 kw, respectively. Because the line voltage was only 208 volts, the ten panels installed in the test bungalow consumed only 8.2 kw of electric power; and since the installed capacity did not exactly equal the heat loss on a room-by-room basis, some of the rooms of the house when uninsulated were slightly under-heated at an outside temperature of 0F.

After the walls were insulated as previously described and storm windows were installed, an attempt was made to heat the house with six panels at an outdoor temperature of 0F; two panels were used in the living room and one each in the other four smaller rooms. Some of the rooms

were found to be underheated because the heat loss of a particular room exceeded the installed capacity of that room. The six panels, operating steadily, consumed 4.92 kw. These results indicate the desirability of having heating units of varied capacities, so that the installed capacities would more closely approximate the required heat loads.

Panel Surface Conditions

The maximum temperature observed on the gypsumboard wall surfaces behind the glass heater panels ranged from 69F to 87F for the various tests, the highest temperature occurring back of the panel beneath the casement window in the kitchen where the panel was in contact with the wall surface. The wall surface temperatures were lower back of the panels in the other rooms because the panels were mounted with a ¾-inch air space between the wall surface and the frame of the heater. When the walls of the house were uninsulated, the temperature of the wall surface back of the heating panels decreased as the outdoor temperature decreased. The same result did not occur consistently when the walls were insulated with 3⅝ inches of vermiculite.

For the case with the greatest temperature difference between inside and outside wall surfaces, the rate of heat loss through the wall area back of a heating panel exceeded the rate of heat loss through an equal area of outside wall not covered with a panel by about 15 Btu per hr. It is thus apparent that the wall surfaces back of the heating panels were neither overheated nor transferring an appreciable percentage of the heat output of the panel to the outside air.

Setbacks and Demands

The effect of evening setback of the thermostats and morning pickup of room temperature on electric-energy consumption and power demand was studied for the house with insulation at 0F outdoor temperature and the results given in Fig. 5. The average room temperature did not reach steady state at 55F until four hours after the thermostats were set at the lower value. Since some of the rooms cooled more rapidly than others, some power was required after two hours of elapsed time. The power demand did not reach steady state until eight hours after lowering the thermostat setting. When the thermostats were reset to the higher value, the power demand jumped to a peak of almost double the steady-state power demand, and did not decrease to the steady-state demand in 3¾ hours. It took three hours for the room temperature to return to 69.5F.

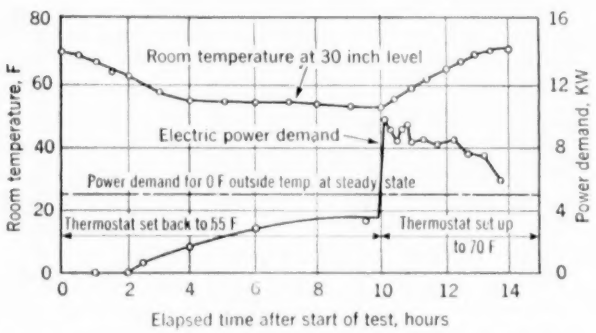


Fig. 5. Changes in room temperature and power demand during night cooling and morning pickup under conditions where house was considered insulated.

If the room temperature had been 65F when the thermostats were advanced, the same 20-minute peak power demand would probably still have been required but the room temperature would have been raised to 70F in approximately one hour. That is, in any locality where the utility company based its demand charge on the maximum sustained usage for any 30-minute period, the demand charge would be based on a 9.7 kw power requirement for the insulated test bungalow whose heat loss at design temperature was only 5 kw, if night setback of the thermostats and simultaneous advancement of all thermostats were practiced.

The effect of an interruption of the power supply on the room-air temperature was measured for the uninsulated house. The room-air and wall-surface temperatures began to decrease immediately upon shutting off the power. An average decrease in room-air temperature of 7F occurred in one hour after the power supply was shut off with the temperature at 32F outside; a decrease of 12F occurred in one hour after discontinuing the power supply at 0F outside. For the insulated house, the room-air temperature decreased only 2.5F during a one-hour period without power at an outdoor temperature of 0F.

The pickup of the power demand for a rapidly decreasing outdoor temperature was observed for the test bungalow in its initial condition and again after insulating the walls and installing storm windows. With the house uninsulated, the wall temperature began to decrease almost immediately after the outdoor temperature started to drop and the power demand rose sharply within a half hour. In the case of the insulated house, the wall surface temperature had decreased only one degree five hours after the outdoor temperature started to decrease, whereas the outside temperature had dropped to 13F during the same period. No appreciable use of electrical energy was required until 2½ hours after starting the test.

The test data further showed that the electric power demand increased more gradually and with a greater time lag in an insulated house than in an uninsulated one. As might be expected, the data also indicated that for cyclic decreases in outdoor temperature lasting for 6 to 8 hours, such as those that occur at night in many areas of this country, the actual rate of heat loss does not reach as high a percentage of the design heat loss rate in an insulated house as in an uninsulated one. Further study might show that a higher design temperature can safely be used for well-insulated houses than for uninsulated houses.

Tests for Thermal Shock

One type of glass panel was subjected to thermal shock tests that were designed to simulate the following three situations which might occur in a house using radiant glass heating panels:

(a) Rain water trickling down over the glass panel from a window sill.

(b) A glass of cold water thrown on the panel by a child.

(c) An accidental spraying of the panel by a shower bath head in a bathroom.

For the first test, cold water at a temperature of 50F was trickled for 10 minutes over two glass panel specimens along the center line from a few inches above the panel. Neither of the panels broke and there was no measurable change in the current used or in the power demand. Similar results were observed when a glass of water at a temperature of 50F was thrown on the glass plates at their centers.

A water spray from a garden hose ranging from a light spray to a heavy spray was directed on the faces of two panels for 3 minutes at distances ranging from 18 inches to 8 feet. The water temperature ranged from 65F to 75F and the panel was brought to a steady operating temperature before each trial. No breakage resulted from this treatment. In several of the tests, the panels were cooled sufficiently to increase the current 1.25 amperes and to increase the power demand by amounts ranging from 150 to 300 watts above the steady value when operating continuously. No short circuits occurred in the electrical system although the insulation resistance decreased considerbly in several cases when the asbestos insulation on the connecting wires was wetted.

The panels subjected to the thermal shock tests were stock specimens made of prestressed glass having good resistance to mechanical or thermal shock on the front and back faces but with much less resistance to mechanical shock at the edges. They could be broken by a relatively light blow on the edge, and when broken, fractured throughout the whole plate.

Results of Tests

The results of these tests indicate that electrically-heated radiant glass panels constitute a satisfactory method of warming a basementless house from the standpoint of temperature gradients in the vertical and horizontal directions, floor temperatures, and general comfort. Accepted methods for the calculation of the heat loss of a house may be used in determining the total capacity of the heating units required. The total energy required to produce a desired condition of warmth in a living space can, in many cases, be slightly less with such electric panels than with other more conventional methods of heating because of the absence of piping or duct heat losses, because the reverse heat losses from the heating elements are lower, and because the individual room thermostats can more readily prevent overheating of any of the rooms.

Compensated room thermostats with very low differential that produce rapid cycling of the heating units are desirable with these heating panels to provide a continuous emission of radiant heat, since the cessation of radiation between heating cycles is quite noticeable when the off period is of long duration.

A control device for the system which will permit heating of the house to a comfortable level at design outdoor temperature, but will limit the electric power demand to a value approximately equivalent to the design heat loss rate, is desirable both from the standpoint of the consumer and the utility company.

Using Electric Heating

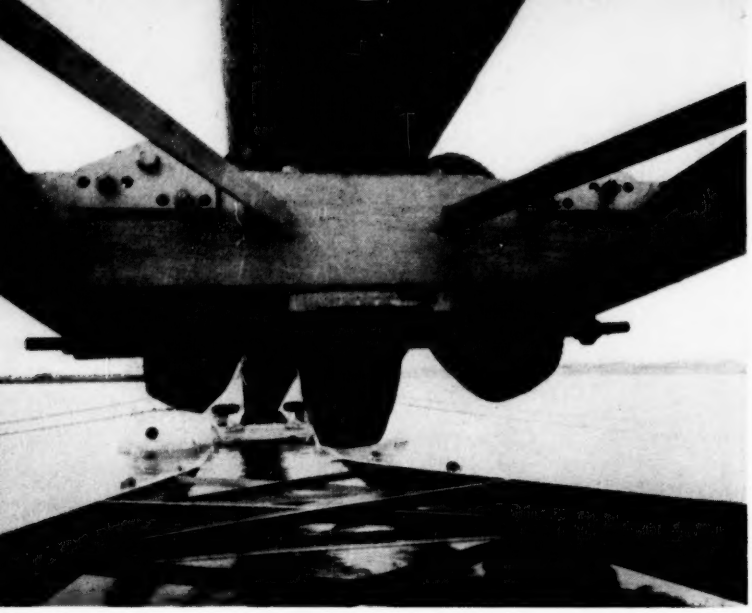
Electric heating has obvious advantages of cleanliness, flexibility, and ease of control. However, houses should be thoroughly insulated to the extent of 3 or 4 inches of a material of low thermal conductivity in the walls, floor, and ceiling and should be equipped with storm windows and weatherstripping in preparation for radiant glass heating, because in most regions heat derived from electricity is considerably more expensive than heat from other fuels in common use. In most localities where the electric rate for heating exceeds 1½ cents kwh, the cost of electric energy for heating a thoroughly insulated house can be expected to be more than the cost of coal, oil, or gas for heating the same house without insulation.

The Effect of Odors on Food Flavor

The flavor of food is subject to many contaminating effects during cold storage. These potential flavor contaminants include odors from the storage structure itself and its insulation, from the organic material which has inevitably been adsorbed in the storage structure, and vapors and gases from the stored food itself, especially when parts of the food have begun to decay. In mixed food storage the danger of cross-contamination of flavor is always present, especially from spiced meats, cheese, pickles, as well as from small overlooked quantities of decaying meat or rancid fat. The rate of flavor contamination of stored food depends on the concentration of foreign odorous vapors in the atmosphere.

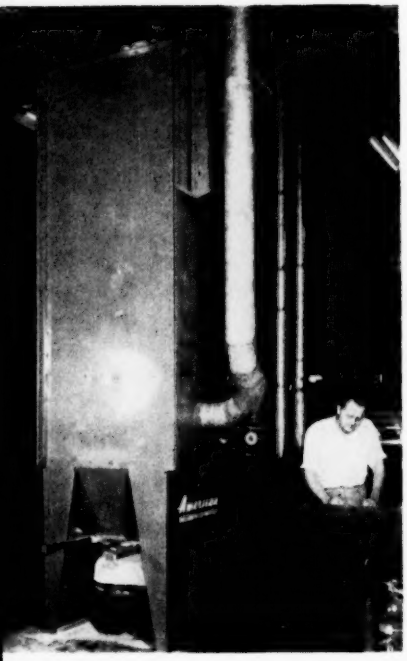
Food storage experiments were carried out by Connor Engineering Corp. in two duplicate commercial walk-in coolers, one designated as the carbon and the other as the control room. The air in the carbon room was purified by circulating it continuously through two canisters filled with activated carbon. Identical fresh food (meat and butter) was kept in the two rooms and was subjected to various sources of contamination. These contaminating sources included spices, sauerkraut, pickles, paint, onions, melons and spoiled meats and rancid fats.

The flavor of the food was judged by a panel of ten food tasters, all selected from a representative group of office and plant employees. The taste scores and their statistical analyses showed highly significant differences in meat and butter flavor due to removal of atmospheric odors by activated carbon. Foreign odors will contaminate food flavor to a degree which depends on the prevailing odor intensity in the storage space and the duration of food storage in the odorous atmosphere. Food flavor contamination by atmospheric odors is not practically significant when the odor level is too low to be detected by the nose. Thus the positive removal of odor in a food storage space is, for all practical purposes, equivalent to the effective elimination of flavor adulteration by airborne odorous vapors.—Amos Turk, Connor Engineering Corp.



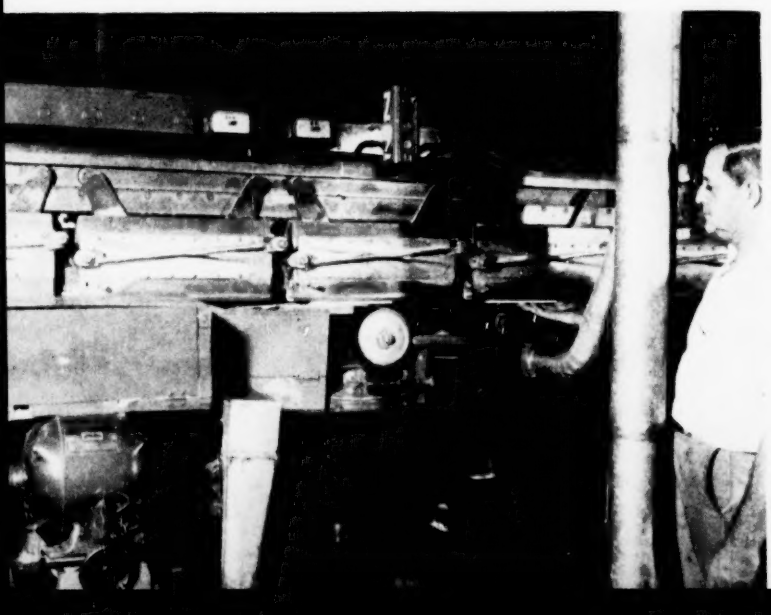
(Left) One of the toughest pipe laying jobs ever encountered was recently solved by Transcontinental Gas Pipeline Corp. with the aid of 18 Firestone heavy duty tires. To lower 6514 feet of concrete encased steel pipe weighing 588 lbs per foot, across the Narrows of New York Harbor, the Collins Construction Co. of Houston, Texas developed this ingenious pipe launcher. Winches on the Brooklyn shore pulled the pipe across the Narrows through a 25 foot trench in the bed of the stream.

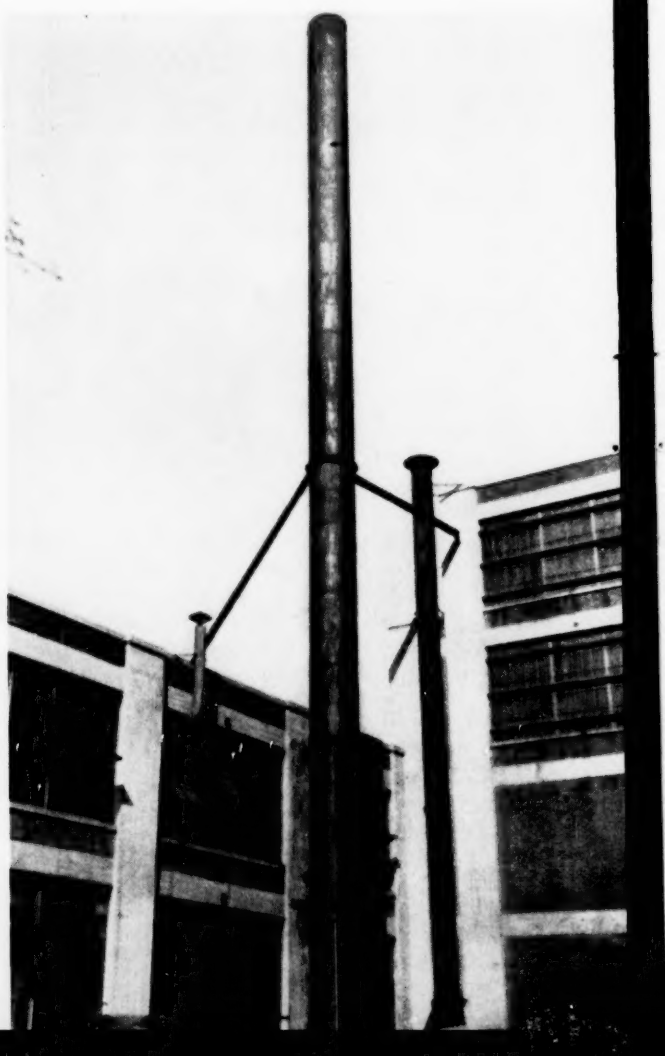
Picture Paragraphs



Paper dust created in the binding of books can be trapped before it finds its way into the working areas of the plant and makes good housekeeping difficult. (Below) Three dust-producing stations in a bookbinding line at an eastern bindery are shown. The first station is a saw trimmer. Just to the right of it is the second, a sanding belt which smooths rough spots on trimmed pages. A third station is just left of the man's head. This is a rotary brush for removing fine clinging dust. Dust from all three of these stations is completely controlled at this plant. The hooding and duct work are on the belt sander and brush. The duct work on the saw trimmer is out of range. (Left) The dust corralled at these stations is carried via the main duct to a Dustube cloth-tube-type collector, manufactured by American Wheelabrator & Equipment Corp., Mishawaka, Ind., where it is trapped for disposal.

(Below) Erected in one day by workers of the C-W Boiler Company, Holliston, Mass., this wrought iron smokestack, 100 feet high by four feet in diameter, serves Plant No. 2 of the Farrington Mfg. Co., Boston, producers of display packages, charga-plates and jewel boxes. The stack was pre-fabricated in three sections and trucked to the plant site where the sections were welded together. Engineers selected wrought iron plate to achieve maximum service life for the installation and to protect against corrosive flue gases created by the plant's incinerator and oil-fired heating boiler.





Health and Ventilation in an Air Conditioned Shop

J. W. HAMMOND Industrial Hygiene Engineer and
R. J. DAVIS Designing Engineer, Humble Oil & Refining Co., Baytown, Texas

Problems involving vapors, fumes, and dust arising from the various crafts found in an air conditioned mechanical shop are discussed. Solutions employed at the shop are presented, and the industrial hygiene and ventilation technics involved in planning of the shop are described, based on a paper delivered at the 13th annual meeting of the American Industrial Hygiene Association.

THE knowledge that health and comfort factors in employee environment are major influences upon production has highlighted the increasing emphasis upon industrial hygiene and ventilation. Cognizance of this fact was taken in the design of Humble Oil & Refining Company's mechanical shop in Baytown, Texas, which was completed in 1951.

Complete air conditioning was planned for the shop, and solutions to as many of the foreseeable problems as possible were made intrinsic in the design. However, some of the vapor, fume, and dust problems were later created by increased personnel, new methods and equipment, and operations. These situations created nuisances and potential hygiene problems that justified investigation.

Air Conditioning in Building

The shop has a volume of approximately 7½ million cubic feet. Spaces for the crafts are divided into work bays. A bay down the center (Fig. 1) houses the offices, lockerroom facilities, and tool rooms and serves as a space for the utilities, including the air conditioning equipment. The total air-conditioning load is more than 1,500 tons. Outside air make-up is approximately 125,000 cfm for summer operations which gives one air change per hour. For winter operation, 250,000 cfm of fresh air is used. Approximately 500,000 cfm of air is circulated by the air-conditioning equipment at all times.

During the summer months, the inside temperature is maintained at 78F, with an outside dry bulb temperature of 95F or lower, and an outside wet bulb temperature of 80F or less. The relative humidity is maintained at 50% by the use of steam reheat. In winter, the temperature is maintained at a minimum of 72F with 15 psi steam. A relative humidity of at least 30% is maintained throughout the winter heating season, except that the steam grid humidifier is automatically disconnected when the outside temperature drops to 32F. Calculations indicate that condensation may take place under these conditions unless the relative humidity is lower than 30%. Chilled water centrifugal refrigeration machines are used with Freon 11 as the refrigerant.

Fig. 1. View of shop shows machine bay in foreground and offices in center bay in background.

The large outside doors are interlocked with fresh air dampers to control as uniformly as possible the fresh air make-up. This a necessary innovation to limit the load on the refrigerating or cooling equipment. One half of the fresh air intakes automatically close when one or more doors are opened on the same side of building. In

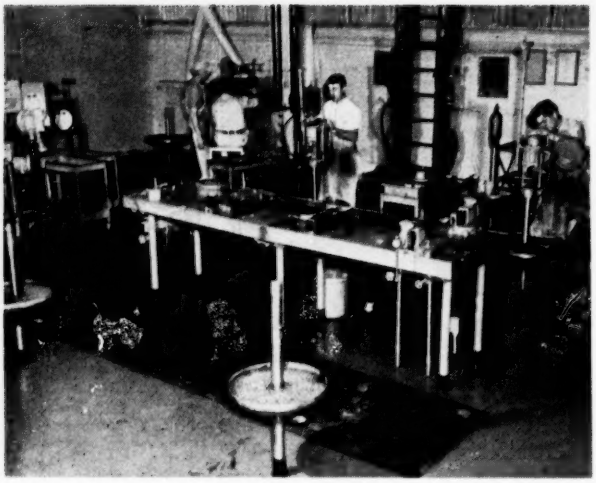


Fig. 2. Section of orifice meter shop shows new pipe legs on the table in foreground, floor covered with battleship linoleum, and complete stainless steel equipment.

like manner, the other dampers are controlled by doors on the opposite side. A 20 mph wind blowing through doors on opposite walls will displace the entire air contents of the shop within a few minutes.

Mechanical crafts employed in the shop are pipefitters, machinists, welders, pipebenders, blacksmiths, sheet metal workers, electricians, instrument men, and boilermakers. A total of 72,000 cfm is exhausted from the paint spray booths, furnaces, tool grinders, welding hoods, metallizing booth, and instrument cleaning and mercury handling area.

Meter Shop Problem

The first problem which came to attention after the completion of the building, was mercury vapor in the orifice meter section (Fig. 2) of the instrument shop. The concrete floor which was poured and sealed against mercury penetration, immediately cracked and was replaced. The second concrete floor also failed in the same manner, and for this reason, it was not replaced but was covered with battleship linoleum. Steel workbench tops and orifice meter stands were painted with the usual industrial type paint. Scratches and chips in this paint formed an excellent place for mercury to lodge, making it practically impossible to cleanse these surfaces. To remedy this, the equipment was replaced with stainless steel. New workbenches were supported upon pipe legs and all joints were welded to eliminate pockets where mercury might collect. Shop shelves and racks were placed on casters to facilitate cleaning of the floor. Storage cabinets for tools and used parts were connected to the exhaust ducts.

Removal of Mercury Vapor

An interesting experience came out of the first attempt to lower the mercury vapor in this shop which was only slightly above 1 milligram per 10 cubic meters. The air supply for this shop, which was 3,500 cfm, was increased to 6,000 cfm. Further tests showed that the mercury vapor concentration was not reduced as expected but actually almost doubled. There was a loss for an explanation because there were no changes in operations, cleaning, and volume of work that should have adversely influenced air concentration. The ventilation rate was changed during the winter season. Under the same conditions, a study while the air-refrigeration unit was operating, showed mercury vapor conditions in the room to be satisfactory. It was discovered however, that the temperature was on the cool side from a comfort standpoint. On the other hand, when it was necessary to use heat, the temperature became uncomfortably warm, reaching 82 to 85F. This information indicated that the orifice meter shop was getting more than its share of the ventilation. An investigation showed that the unbalanced condition was produced by exhaust through the 10,000 cfm spray-paint booth which was in this shop. A partial vacuum resulted, causing a greater than calculated volume of air to be forced through the inlet-air ducts. Low temperatures during the air-refrigerating season suppressed the mercury vaporization to concentrations quite low but the extra heat during the cold weather increased the vapor pressure of exposed mercury enough to create a problem.

One corrective measure considered by the engineering division was a separate cooling and heating unit for this shop which would be thermostatically controlled and independent of the rest of the shop. An alternate measure was the installation of controlled louvers on the outside walls to permit fresh air to satisfy the demands of the exhaust fan whenever the temperature either exceeded or fell below the selected standard. A separate cooling and heating unit for this section was decided upon. That change made conditions comfortable for all seasons and the average atmospheric mercury vapor concentration is less than one half of the allowable. The supervisor feels that the shop's efficiency has been improved.

Smog from Welding Bays

During the first summer that the shop's air-conditioning was used, it became obvious that a smog problem existed. It should be recalled that during the summer only half as much fresh air is brought in as during the heating season. Although the welding shop (Fig. 3) was

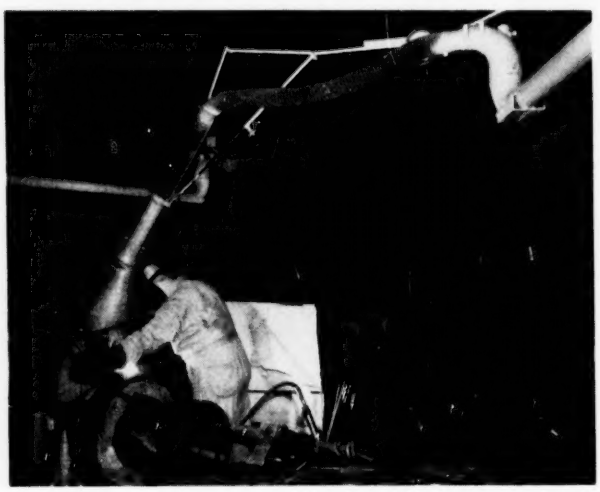


Fig. 3. Operations in one bay of welding section. Flexible duct takes fumes to exhaust system.

suspected of contributing most of the fumes, no complaints came from that section of the building.

Studies were made to determine the amount of material in the atmosphere and its nature. Samples of settled dust were taken from structural beams near the ceiling of the building, as well as from glass test plates which were placed in elevated locations to determine settling rates.

These settle samples were analyzed and found to consist of:

Ash	85.6%
Volatile and Combustible Material	14.4%
Fe_2O_3 (ash basis)	59.0%
Silica SiO_2 (ash basis)	23.0%

Spectographic analysis of the ash showed the presence of minor amounts of calcium manganese, aluminum, titanium and copper, in addition to the above tabulated materials.

It was of interest that the settled material was in part magnetic, indicating that magnetite was being produced by some operation. The presence of this in later air samples was watched for, and it was discovered that the metallizing gun was primarily responsible.

Welding Air Analysis

Air samples were collected by means of the MSA electrostatic air sampler and these were analyzed in the usual laboratory methods as well as by spectographic methods. Quantity of fumes per cubic meter of air ranged from 6 milligrams per cubic meter to 47 milligrams per cubic meter. The highest concentration was found in the welding bay. Spectograph analysis of these samples did not differ from those reported on the settled samples. Although none of the work up until this time indicated that there existed the concentration of a particular material that would introduce a health problem, we began to receive complaints of throat and eye irritation. At this point, sampling for vapors as well as fumes was begun to determine if the re-circulation of air permitted the converting of NO to NO_2 and the building up of ozone to irritating concentrations.

In a welding fume and gas study by Silverman and Husain, it was found that each welding rod burned per hour would produce a definite increase in the total fumes and nitrates if the air was re-circulated. By what appears to be reasonable conversion factors, these results were used in calculation of the probable concentration of nitrates after 3 hours of welding. The determined value for general air samples checked very closely with the calculated value of 0.24 ppm.

Fume samples at the welders' exposure showed about the expected concentration of total fumes ranging from 15 to 150 milligrams per 10 cubic meters. The composition was similar to that for mild steel rods and coating. The general air contained about half as much fumes as did the atmosphere around the welders and the quantities ranged from 7.8 to 70 milligrams per 10 cubic meters.

At the metallizing gun, while metallizing on a large cylinder which blocked the exhaust hood, the concentration of fumes reached 2,100 milligrams per 10 cubic meters. The concentrations while working on materials of small diameter were within the suggested limit of 300 milligrams per 10 cubic meters. Of interest to us was the fact that the operator complained of molybdenum fumes because of its throat irritating properties. In this respect, it may be worse than iron, chromium, nickel and vanadium. It is used extensively as a bonding agent between the object and the new metal applied with the metallizing gun.

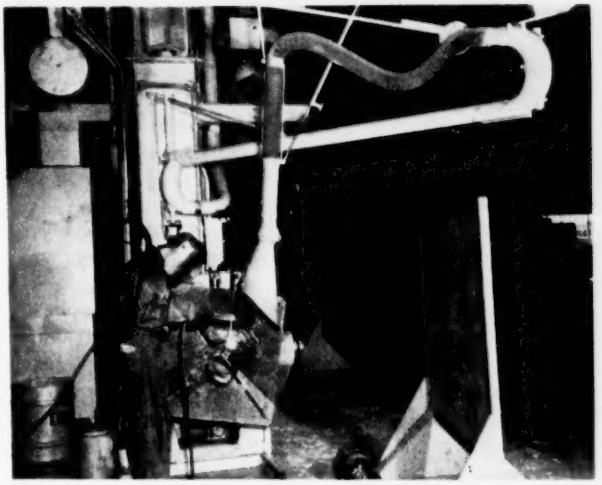


Fig. 4. Exhaust system in welding bay features 12-foot metal extension between swivel joint at unit and flexible duct, which was added for overlap when welders worked 6 to 19 feet apart.

Welding Exhaust

In the welding bay, 28 Ruemilin units were provided which is about the number of welders working at any one time. Because of the length of pipe and large pieces of equipment, the standard coverage arc of the hoods was not large enough. Also, it was discovered we needed a considerable degree of overlap to take care of numerous instances where two or more welders worked within 6 to 19 feet of each other. The units were adapted to our needs by adding a 12-foot metal extension between the swivel joint at the support and the counter-balanced flexible duct as shown in Fig. 4. Better location of the work was also put into practice. Such measures have reduced the smog problem but have not entirely eliminated it as a nuisance.

Two charcoal furnaces used to preheat bronze parts before bronzing, from which carbon-monoxide in significant concentrations escaped, have been replaced by an electric furnace.

The presence of water-soluble aldehydes found in low concentration in the general air was attributed primarily to welding and burning on metals soiled with greases and oily films. Small quantities may be produced in the machine shop, and the exhaust from the gasoline crane and fork-lift trucks contributed some amount.

An industrial-type X-ray unit is used to check on the quality of welds. It operates at about 10 ma at 170kv. An area of about 10 foot radius is roped-off around the unit while it is being used. Outside of this zone, the maximum reading was 6 mr per hour and the MAC for a 40 hour week is 7.5 mr. The highest reading recorded well inside the rope was 12 mr per hour. Inside the lead-lined operator's cabinet, the reading was 0.5 mr per hour. This unit is only used a few hours weekly, therefore, the precautions taken in the use of the x-ray unit are adequate.

What's New That's Unusual

T. W. REYNOLDS

A review of trends and things new or unusual covering boilers and furnaces, piping, valves and accessories.

AIR binding has been a problem in hot water heating systems. There is a liquid chemical deoxidizer which helps to prevent air pockets. One gallon is sufficient for 100 sq ft of radiation or for 44 gal water capacity. There is also available an automatic hot water air vent valve which contains a hygroscopic disc to swell upon water contact and close against the water. Subsequently, heat from the radiator dries the disc and its cells open to vent air.

For the killing of germs in the air there are now a number of glycol vapor dispensing devices for placement in air conditioning ducts or directly in the occupied space of the home, office or factory. Absenteeism from colds and respiratory ailments is thereby reduced. For the killing of flies, mosquitoes and moths there are other forms of vaporizers. What a help these insect vaporizers should prove in the hotel kitchen and in other places where doors must be opened frequently.

Moisture Removal

Refrigeration may produce moisture or it may remove moisture. Thus it may cause sweating around doors in refrigerated places, or it may be used to remove moisture from compressed air lines, thereby increasing the life of piping and bettering the operation of compressed air tools. There is also a type of pet cock which automatically ejects moisture from air line traps.

For building walls there are wall vent tubes, Fig. 1, with 1/16 inch slots to relieve pressure and moisture from a wall interior. This allows some circulation of the air in the wall and reduces the condensation therein.

We are often busy getting moisture into some places and out of some other places, although the most troublesome is moisture removal. We now have portable humidifiers, convectors with humidifying pans attached, and air valves that can be set to humidify. As opposed to these, there are a number of small electric dehumidifiers for the home or office and for use in damp basements.

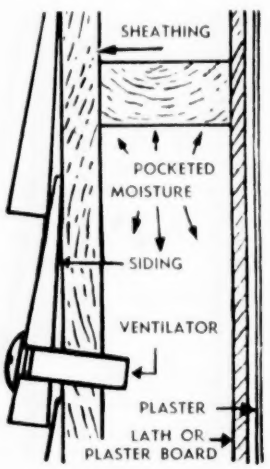


Fig. 1. Vent tube inserted in a building wall to relieve pressure and moisture from inside of wall.

Exhaust fans in kitchen and laundry, a humidity indicator and a dehumidifier all would help to eliminate moisture from a house. New homes that are too tight due to thorough insulating and weatherstripping are apt to have the paint peel off exterior walls. Moisture condenses behind the paint and then comes the sun to cause paint blisters.

Moisture from the concrete of the roof, walls and floors is troublesome in new industrial buildings, especially to the veneer of furniture in warehouses. That from the floor, which condenses on its surface and damages floor covering, could be avoided if the temperature of the concrete could be made to correspond to surrounding air temperatures and also remain above the dew point.

Fill a warehouse with furniture and the furniture will radiate heat to the cold floor and from there it will find its way to the ground. However, multiple sheets of accordion aluminum under the slab will reflect back the radiation. In one plant a vacuum device was used to remove water out of the wet concrete floor slabs before the concrete began to set.

Perhaps the most annoying thing about moisture, because it is so close to home and body, is the sweating of toilet flush tanks. It is interesting to observe the various methods for preventing this. For example, one manufacturer produces a plastic tank cover with a dead air space and makes this cover in three colors for various decorative plans and in sizes to fit all tanks. Others produce hot water mixing valves or an electric immersion heater for the same purpose. Even the bath room cabinet mirror can be electrically heated and have its temperature thermostatically controlled to remain above room temperature.

Fuel Oil Tanks

To save on the floor space required for the smaller oil tank, a chain arrangement is now produced to hang the tank high up on a wall. The manufacturer claims that the insurance underwriters will accept the elevated location provided the tanks are properly installed.

A manhole oil preheater for bulk storage tanks, which is called a hot spot preheater, is marketed for preheating oil before the oil enters the suction line. For the domestic fuel oil tank, there are many devices for better and safer filling. There are fill vent boxes set flush for neat appearance and fitted wth a vent which allows a fast fill, a spill guard, and a gage readable in the dark to indicate height of oil in the tank. There is also a nozzle plug for quick yet safe fill which has a safety valve to pop off at about 5 psi to prevent rupturing the tank. Blow backs and spillage are eliminated.

An outdoor heat measuring unit together with a fuel

requirement anticipator enables a dealer to know when the fuel tank should be filled. When an oil tank is empty, air must be eliminated from the fuel oil unit. Some fuel units have vent cocks provided for this purpose. There is also a vaporstat alarm which will give warning that oil is low in the tank and also stop the oil burner in time to prevent air binding.

A fuel oil deodorant can also be obtained for oil leakage, or where there is any spillage. The deodorant is in the form of a powder for spraying on the leak or sprinkling the basement floor. It will also remove most of the oil stains. Also of interest is a collapsible drum of rubber, weight 30 lb, to hold 55 gal of oil. The drum is easy to lift, handle, roll, stow away, clean and empty completely, since it has no corner pockets.

Boilers and Furnaces

In the First National Bank Building, Tulsa, Okla., the boilers are near the top of the 21-story structure; they are also near the top of the Employers Insurance Building at Dallas, Texas. While such an arrangement creates a few problems, it eliminates many others. For example, the ventilation of the boiler room and introduction of outdoor to air conditioning equipment is greatly simplified. In one of these structures the boiler room is even cooled by throw-away conditional air. Valuable space in the basement and chimney space on each floor also becomes available for other purposes. Furthermore, there is no overheating of the floor over the boiler room or a need for insulating this floor. The air conditioning load is thereby reduced.

Fig. 2. Protection for boilers installed temporarily in the open.

On construction jobs, boilers temporarily in the open have had the front enclosed in a simple enclosure called a dog house, Fig. 2. Latest thing in recent years in very large boilers is: Television to visualize plant combustion, water cooled windows for the same purpose, spreader stokers to burn wood waste. In the case of residential boilers there is an oil-fired boiler with a tube in tube, the water going up one tube and down the other. One make of steel boiler has been split in two to pass through narrow doorways and hallways and it also has a low water line to keep within headroom and save excavation for a pit.

An expandable furnace, consuming oil or gas fuel, is arranged so that component parts can be added as desired for houses with future expansion. Another furnace will take any fuel such as coal, coke, oil, wood, waste paper or garbage. Residue drops into a removable drawer. Still another furnace is provided with an air economizer system which automatically decreases the amount of outdoor air taken in as the outdoor air temperature decreases. There is also a gas boiler which by outdoor thermostat switches the source of heat from natural gas in the supply main to any bottled low pressure gas reserve.

Two other boilers have recently been produced for use with electric heat. They are convenient for use where medium pressures and small boilers are required of only 1½ hp capacity. Maximum pressures with these boilers are 15 psi for one and 50 psi for the other. Heat is generated by the resistance of the boiler water to the flow of current between solid metal electrodes, hence should there be no water in the boiler there will be no current flow. Advantages are no coils to burn out, tubes to scale up, fire hazard, or low-water hazard.

Baffles may be obtained for fire tube boilers; boiler jackets for both heat and sound insulation; Tintex to color the water in a steam boiler to make the water line in the gage easy to see; and there is a heat waste indicator for the chimney flue which automatically points when the flue gas temperature is too high. It can be set to suit the kind of fuel used. Another device, pertaining to the smoke pipe, is a miniature sheet metal boiler or heat exchanger for heating water free. It consists of eight tubes for gas furnaces and one large flue for coal-fired furnaces. This heat exchanger replaces a 30-inch length of the smoke pipe.

Chimneys

The modern tendency is to eliminate most of the chimney and the space it requires, either by putting the boiler in an attic or lean-to outdoors, or by some design which will greatly simplify its construction, such as light weight prefabricated vitreous lined round chimney. There is also a double wall flue pipe of aluminum which uses outdoor air for insulation. The flue gases go up a 6-inch central core while the cold air comes down around the core. The flue pipe is approved by the Underwriters Laboratories for zero clearance of framing and partitions. Chimneys of low height can be fitted at the top with caps providing venturi action. Should a chimney need cleaning, one can now use a collapsible chimney brush that has been made for that purpose.

Fuels

Long distance transmission of natural gas has made such gas available to many householders. The State of Nebraska advertises for industries to come where there is natural gas, a cheap fuel. Even a lumber camp with high paid labor finds natural gas from a source 200 miles distant cheaper than preparing its surrounding free wood for fuel. Sewer gas is used in a direct fired heater in a municipal garage at a sewage disposal plant and our government is experimenting with the pumping of pulverized coal through a 12-inch pipe line three miles long.

Incinerators

The incinerator is finding much wider use in the home. One may be obtained which can be connected to the cellar chimney in the basement. It can use dry waste fuel or can be equipped with a gas burner. A removable pan or drawer collects the residue. The incinerator in my home

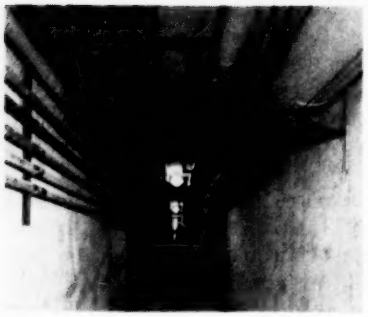


Fig. 3. Metal framing designed to support several runs of pipe.

was at one time merely the bottom interior of the chimney with waste fired through the opened cleanout door.

Flues from gas-fired incinerators are connected to the chimney with reference to the main pipe of larger gas-using equipment, but never opposite. Sometimes a wye connection is used for both flues. When the incinerator flue is above or below the main smoke pipe, it may project in 4 inches farther than the main smoke pipe. The idea in this case to by-pass the gases from the larger fire, but it is not necessary because the incinerator has a direct flue connection, whereas the boiler or furnace has a draft divertor which prevents back draft action of incinerator gases.

Piping

Pipe materials and their insulating coverings are undergoing changes. Plastic pipe is easier to handle and some pipes are being insulated with glass. Pipe joints may now be protected with zipper jackets.

Large diameter thin wall pipe has made necessary a thorough study of pipe hanging methods. Large pipes, under certain conditions, require expensive and more elaborate hangers such as those which give constant support whether the pipe is hot or cold. One metal framing system for pipe support, Fig. 3 is of interest, especially for conduit and pipes in tunnels. It is neat in appearance and by continuous slot, provides quick hanging.

Piping and valve identification is no longer a nuisance to the contractor or a problem to the plant operator. There are available metal name plates, 1½-inch diameter aluminum discs, and labels in standard symbols and colors that stay regardless of heat and humidity. Or you can make your own labels from a labeling tape on which one can write with a pencil, stylus or typewriter. This tape is proof against smudge, dirt or water and temperatures up to 160F.

Identification of piping by color alone becomes a nuisance in repair work where replacement with the same color is often inconvenient. The worker has to carry about a little booklet of sample colors and some workers are color blind. It seems a much better method to paint piping all one serviceable or good-appearing color, or as required to match the surroundings or equipment. With this idea in mind, certain designating stencil labels have been developed on which there are also directional arrows in multiple.

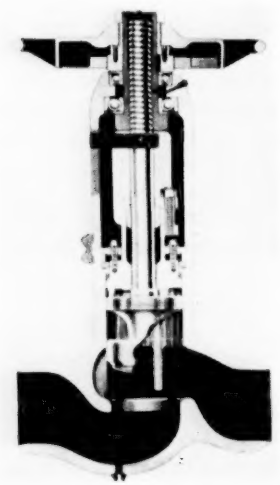


Fig. 4. Section through a cast steel globe valve to show its stream-lined flow.

Valves and Accessories

When we think of a valve we think in the singular and that is the trouble. One begins to realize the importance of valve selection when one is told that there are 4,715 valves of one make in the building at 100 Park Ave., New York City.

It is of interest to note that a globe valve, Fig. 4 has been designed which has streamlined flow and full channel. A combination elbow and balancing hot water valve is available which can be adjusted to allow only enough water to pass to prevent freezing. A three-valve by-pass fitting is also interesting since it does away with as many as 14 threaded joints with their inherent liability to leakage and maintenance. Labor is saved at no greater cost for material.

Among many improvements, in accessories there is the scraper strainer that cleans and therefore allows a finer mesh screen to be used. No labor on shut down for cleaning is required. The no-turbulence compression pipe coupling is another improvement. Then there are thermometers that measure surface temperature, others that can be rotated to any position, and a reset outdoor thermometer that registers the temperature and also the high and low for the day. It is reset by means of a push button.

A steam trap with glass ports for visual flow was introduced about two years ago. An interesting application of a steam trap to a high water boiler alarm was made recently. The trap, Fig. 5, is piped at high boiler water line and when discharging operates the expansion tube of a pressure gage, thereby making an electric contact ring a bell.

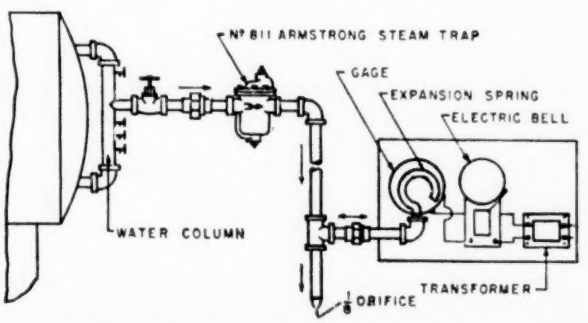


Fig. 5. Trap installed as part of a high water boiler alarm.

Designing for Natural Ventilation in Classrooms

A study of the geometry of classrooms for the best natural ventilation during warm months. The effects of depth, length, openings, and overhangs upon air flow patterns with natural ventilation are discussed.

THE standard practice of designing the shell of school classrooms with the emphasis upon lighting effects and neglecting natural ventilation has not been successful from the standpoint of comfort, particularly in the warm and hot seasons. Designing the classroom to have large window area on one side of the room with escape openings on the other is not sufficient to provide adequate natural ventilation. These points are made by William W. Caudill and Bob H. Reed, research architect and research assistant, respectively, for the Texas Engineering Experiment Station of Texas A & M College in a report recently published by the Station. Their research report concluded that to obtain proper natural ventilation it will be necessary sharply to change present concepts of what a school room should look like.

It is true, the authors show, that in cold months the ventilating air should be directed over the heads of the students to mix with the warm air at the top of the room. Windows used in schools are usually made to tilt inward and upward to aid in this design. However, in the hot months, mechanical convection air is inadequate. More important than the concept of air change in these months is the idea of air flow patterns and speeds. Instead of scooping the air toward the ceiling, it should be directed to a flow pattern around the students. It is with the design of classrooms to obtain the best patterns and speeds for air flow that the Texas study deals.

Methods of Research

Use of full scale classrooms to provide test comparisons was found to be inaccurate, because it was virtually impossible to have standard operating conditions. Therefore, a technic of testing with scale models was developed by the Station research workers. Their research showed that these models would produce flow patterns identical to those of their full sized counterparts. An example of these scale models is shown in Fig. 1.

Fig. 1. Air flow through a classroom is shown by means of a scale model placed in a wind tunnel.

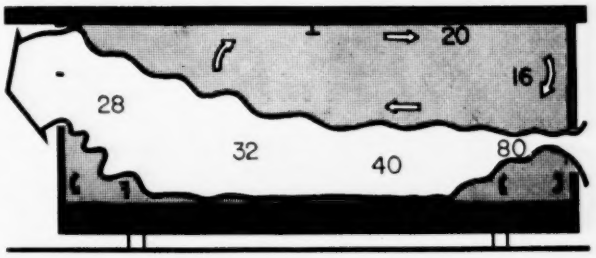


Fig. 2. Diagram demonstrating proper flow across a classroom. Numbers represent percent of outside air velocity at various points in the room. Small arrows trace eddy currents. The intake opening is placed as low as possible on the wall, and the outlet opening is as large as feasible.

The conditions under which the models were placed were simulated, and it was possible to reproduce them as often as needed to test each type of classroom model.

The models were designed in all combinations of the variables that were to be tested. Rooms were built of different lengths and with ceilings of varying heights and slopes. Simple openings were used, and they were varied as to their size, shape, and position on the walls. Overhangs of several types were applied to the models already tested to note change in patterns. Types of windows, effects of landscaping, double-loaded corridors, and rooms vented on three sides were some special arrangements studied.

Some of the findings were doublechecked in a full sized classroom that was built so that it could be revolved to present any surface toward the prevailing winds.

Results of the Study

Dimensions.—The authors conclude that when the height of the ceiling is varied, it has no appreciable effect upon air flow, although increasing the height was found to decrease the number of air changes. Thus the ceiling height is of little importance to comfort. Sloping ceilings do not interfere with correct air patterns.

Length of the rooms was also found to have little effect upon the air stream when the room was perpendicular to the exterior air flow.

Openings.—The standard procedure of having large window area, cross-ventilated by louvers or transoms to provide a scooping effect upon outside air was found inadequate. When no cross-ventilation was provided at all this arrangement is useless. The best solution was found to be in bilateral classrooms in one classroom wings, i.e. classrooms with a pair of opposing walls being

exterior. With this system, it is possible to have openings in the opposite walls.

Experiments in this study with various openings demonstrated that the most satisfactory design would have the outlet openings larger than the inlets, with both of maximum feasible size. The size of the inlet determines the speed of the entering air streams, and the size of both the inlet and outlet determines the quantity of the entering air stream.

It was found that a long slot effect provides the best opening, as it makes for more even distribution of the flow pattern. If the intake opening is placed as close to the bottom of the classroom wall as possible, the flow will be directed around the students. The reason for this phenomenon is that there is a stream of air flowing down the outer surface of the wall. This stream exerts a force in a downward direction and is called the downward force component of the air stream. The more area allowed above the window, the more the air flowing along the wall, and the greater is the downward force component. In fact, it becomes great enough to overcome any upward force component caused by air flowing up the wall below the opening. This flow pattern is illustrated in Fig. 2.

The opposing openings will provide air flow to all parts of the room due to eddies adjacent to the air stream, although the eddies are of very low speed.

Overhangs.—Because of the phenomenon already described as to the effect of downward force components, an overhang placed over the window for natural lighting arrangements will destroy the usefulness of the wall height. However, an overhang can be useful by slotting it or making it louvered. This makes the downward force component even greater. This is illustrated in Fig. 3.

When the overhang is below the window opening, many other design factors influence the air pattern.

Special problems.—In most cases the openings in the studies were equipped with standard type windows which could be pivoted inward and upward. From the hot month point of view, casement windows are more effective. However, the most efficient window would be the type that could be pivoted to direct air flow upward in the cold months and downward in the hot months.

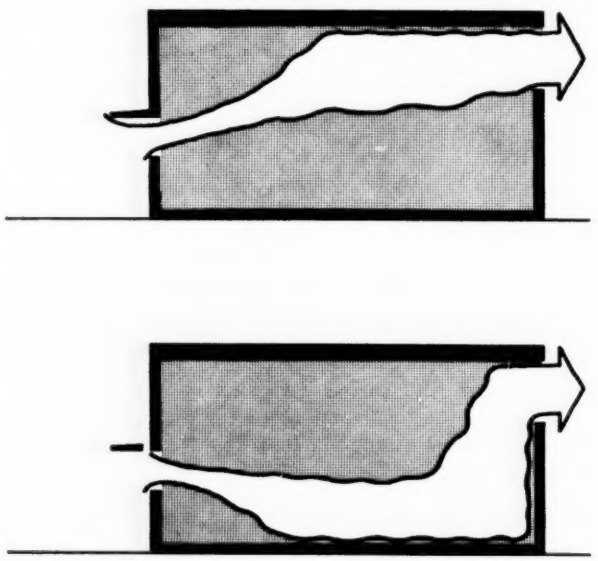


Fig. 3. Top diagram shows effect of solid overhang on flow pattern. Bottom diagram demonstrates the correction of the flow pattern achieved by slotting the hood. Another method of having an overhang while maintaining the proper flow pattern of a simple opening would be to have a louvered overhang.

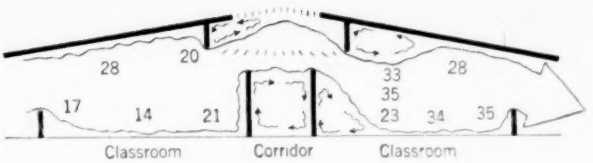


Fig. 4. The air enters through a large opening in one classroom, is directed by slots and baffles across top of corridor, exhausted through opening in opposite classroom.

Another supposition was that the bilateral structures are of the single classroom wing type. Under some circumstances it is not possible to build this type of structure, and corridors with classrooms on both sides must be used. This system often presents problems in gaining proper cross-ventilation. There are two possible solutions to the double-loaded corridor problems.

A very good system, the research showed, would be to use the corridor itself as an air duct. Grilles and baffles in the hallway could direct the air into the rooms, and the flow would be expelled through the large window area in the exterior walls.

The second solution would be to use a cross-ventilation system. The school would be built with its axis perpendicular to the prevailing winds, and the air stream would enter one classroom, flow across the corridor ceiling, and out of the other classroom. This arrangement is pictured in Fig. 4.

Sometimes it is impossible to construct the rambling, finger-type buildings necessary to any type of bilateral system. In these cases multi-lateral structures must be designed. Yet even in this case, natural ventilation can be obtained. Ventilators placed on top of the roof offer one simple solution to this problem that should not interfere with the beauty of the structure.

Recommendations

From the results of the study by the authors, it would appear that a combination of all the best designs suggest a school built along the following concepts: The school would be a rambling, finger-type structure with bi-laterally vented wings for single classrooms. One group of parallel walls would be facing the prevailing winds. The openings on this side would be a row of windows that could be turned upward or downward. The size of the windows would be determined for whatever percentage of prevailing wind speeds is desired in the air stream across the room. The maximum sized intake windows would have considerable wall area above them, and if an overhang was used immediately above the windows, it would be slotted or louvered. The exhaust windows would be as large as possible.

In any case, school buildings can be designed for proper natural ventilation if preconceived ideas on how school buildings should look are discarded.

The full report, issued as Research Report 36 under the title Geometry of Classrooms As Related To Natural Lighting and Natural Ventilation, can be obtained from the Texas Engineering Experiment Station in College Station, Texas.

Artificial Lighting and its Relation to Air Conditioning

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Light conditioning and air conditioning are directly related to the comfort conditions that may exist in a building. Artificial light sources increase the sensible heat within a space and this must be considered when designing a cooling system. Presented in this article are data on recommended lighting levels for various kinds of work and interiors and a discussion of temperature rise from lighting as related to design. In an appendix are data for the design of lighting systems.

TODAY the thoroughly modern building is comfortable for the occupants. It is: (1) bright and stimulating due to adequate light of just the right quality for whatever purposes light is needed; (2) both temperature and humidity are selected and controlled to suit special activities. Moreover, interiors are often equipped with acoustical material to control sound, and in some instances ultraviolet air disinfection adds hygienic and psychologic value to comfort. A recognition of the fact that these practices are indispensable concomitants of the modern scheme of things must premise the thinking of all far-sighted men who are in any way responsible for the planning of new buildings or the rehabilitation of old ones. The thoroughly modern building, in other words, is light, air and sound conditioned, and the men and women who work in them are enjoying the highest standard of work-world living that the American way of life can offer.

The air conditioning of a bulding or any part of it involves several problems, one of which is maintaining comfortable air temperatures. Natural light from the sun and sky coming through windows carries with it a considerable amount of radiant energy much of which becomes sensible heat when it strikes an absorbing surface. Artificial light sources emit heat, much of which is in the form of radiant energy and this acts in the same way.

Therefore it must be recognized at the outset that light conditioning and air conditioning are inherently and fundamentally at variance in their physical aspects. For a lighting system produces heat and an air conditioning system removes heat. The more heat a lighting system generates, the greater the load on the cooling system. Where both are not installed simultaneously, the existence

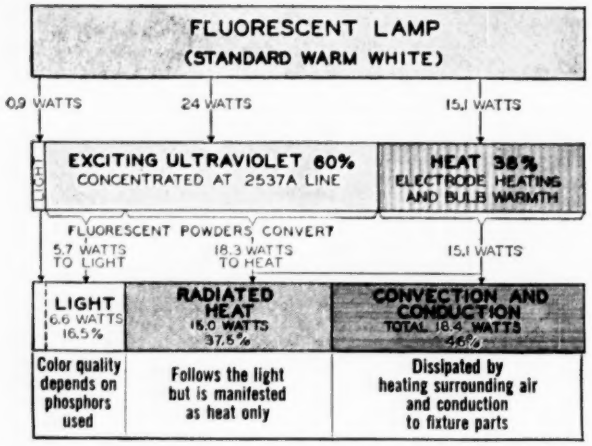

Fig. 1. Distribution of energy from a 40-watt fluorescent lamp.

of one often precludes, from the user's point of view, the installation of the other.

Light and Watts

All types of electric light sources generate heat as well as light, and there is a definite heat equivalent for each watthour of energy consumed which amounts to 3.415 Btu. While this heat equivalent per watthour for electric lamps is a constant value, it is interesting to note that due to the many researches, principally during the past quarter century, the light units generated by each watt have gradually increased. For example, the 200-watt filament lamp of today appears the same as it did 25 years ago, but its light output has been increased from about 3,250 to 3,700 lumens. Of still greater significance of the value of development and research is the increase in efficiency of fluorescent lamps. The 40-watt 3500° white fluorescent lamp of 1939 generated 1,880 lumens, while a lamp of the same wattage and general appearance in 1952 generates 2,450 lumens. Hence, there is no constant ratio between the amount of light generated and the overall watts of connected lighting load. The higher wattage filament lamps are more efficient in light production (lumens of light per watt) than smaller ones, and fluorescent lamps in general are two to three times as efficient as filament lamps. Furthermore, the light output and distribution efficiency of certain lighting units give them an outstanding advantage over other lighting systems when installed for a particular application.

The best procedure for determining the total actual wattage consumed by the lighting system in old buildings is to survey the installation and make a summation of the lamp wattages. In new or remodeled buildings, the summation of lamp wattages should be obtained from the approved and accepted lighting plan specifications.

Energy Analysis from Artificial Light Sources

Filament Lamps. When a gas-filled incandescent lamp of the 300 to 500-watt size is operated at normal voltage in still air, its energy distribution is about as follows (1):*

Radiation in the visible spectrum	11%
Heat as invisible radiation in the infrared region.	70
Heat which is conducted away from the filament through the filament supports and leads	3
Heat dissipated by gas convection and conduction	8
Heat radiated by the bulb	8

Hence from a clear-bulb, gas-filled lamp about 90% of the total energy is in radiant form, i.e., all of it except that dissipated by the filament supports and leads, and by the gas.

Fluorescent Lamps. Fig. 1 shows the approximate distribution of energy in the 40-watt fluorescent lamp. The top bar indicates the electrical energy input, the middle bar shows the conversion of energy within the lamp and the third bar gives the ultimate nature of the energy output. Skillful lamp design and proper operating conditions result in three-fifths of the input energy being converted into exciting radiation, practically all of which is in a single line (2536.7 Angstroms long) less than an Angstrom in width. An Angstrom unit for measuring the wave length of light equals one hundred-millionth of a centimeter. A little over 2% of the energy is represented in the four principal mercury lines within the visible spectrum: 4,047, 4,358, 5,461 and 5,780 Angstroms. The rest of the input, plus the conversion loss in the phosphor coating, is emitted as infrared radiation or is dissipated by conduction and convection. Part of this unavoidable loss keeps the cathodes hot—an essential condition for the free emission of electrons and for highest efficiency at low operation voltages.

The region in Fig. 1 marked "light" represents the radiant energy emitted in the visible portion of the spectrum. This radiant energy plus that radiated in the infrared portion of the spectrum amounts to 21.6 watts or 54% of the total. Keeping in mind that the 40-watt fluorescent lamp is more than twice as efficient as a filament lamp in the production of light, one can readily establish the fact that the radiant heat per footcandle of illumination from the former is only about one-fourth as great as that from the latter.

Effectiveness of Radiant Energy

In burning a bare lamp in an interior, its radiant energy will not be effective in raising the temperature in that interior until it has been intercepted by an absorbing surface which in turn will dissipate the heat by convection. Practically all surfaces such as building materials, room furnishings, and lighting equipment absorb a part of the wave energy reaching them from a burning lamp. As far as the lighting equipment is concerned the amount of radiant energy intercepted by it will depend upon its type.

One of the most generally used types of filament lighting equipment is the white glass enclosing globe. If a lamp is placed in one of these units, it is estimated that on the average the globe will absorb something of the order of 15 to 25% of the 81% radiant energy reaching it from the lamp filament and nearly all of the 8% reaching it from the bulb. Hence, when the lamp bulb is placed in a white glass enclosing globe there will be 60 to 65% of the energy dissipated in radiant form. The remaining 35 to 40% of the energy is dissipated from the lamp and enclosing globe by conduction and convection, and, theoretically, it is only this heat that can be removed from the enclosing globes by a circulating air

*Numbers in parenthesis, unless otherwise indicated, refer to the bibliography at the end of the article.

system. Some attention has been given to this possibility in order to reduce the heating effect in a room. For a similar fluorescent lighting system, the theoretical amount of removable heat would be of the order of 55 to 60% which is appreciably higher than from filament lamps.

But extreme care must be taken in attempting to remove heat by a circulatory air system around fluorescent lighting units because air drafts may reduce the lamp efficiency. The reason for this is that the common sizes of fluorescent lamps operate most efficiently at normal room temperatures of 70 to 80F, where the temperature of the glass tube itself is 100 to 120F. At lower surrounding temperatures the mercury vapor condenses and the activating ultraviolet radiation is reduced. At higher temperatures the vapor pressure is increased and some of the ultraviolet radiation is shifted from 2,537A to longer wave lengths; also there is increased reabsorption of the 2,537A radiation by the mercury vapor.

To what extent the light output will fall off under different conditions of surrounding air temperature is difficult of precise prediction under practical installation conditions. Normal light output is conditioned upon maintaining the bulb itself within a certain range of temperature. This range varies with the different bulb sizes and wattage—one criterion being the watts per square inch of bulb surface provided in the design of the lamp. The actual bulb wall temperature is dependent upon the circulation of air about the bulb, how well it may be shielded, or enclosed. Air drafts conduct heat away from the bulb with a result such as indicated in Fig. 2. In extreme conditions of draft, the bulb temperature may be little greater than the air temperature—a condition realized when lamps are first turned on. The lower limits shown represent measurements of light output made immediately after turning on the lamps and before the bulbs were warmed up. In common usage the values in the upper range would normally apply.

Assuming that no attempt is made to intercept and carry away any of the heat generated by a lamp, the question arises as to what portion of it is actually effective in raising the room temperature or in augmenting the load on the cooling system in an artificially-cooled building. At first thought it would appear that the heat equivalent of the entire energy input to the lamps, amounting to 3.415 Btu per watthour, must inevitably be regarded as being effective. In fact, that assumption is ordinarily made in engineering calculations for a cooling system. However, a close examination reveals that a fairly good safety factor is being applied.

It is to be remembered that the engineer is concerned primarily with heat as it affects human comfort, and this may be either in the form of radiant heat or as heat in the surrounding air. As indicated, filament lamps of the sizes usually employed for general lighting in offices, stores, and factories generate about four times as much radiant energy per footcandle of illumination as obtained from fluorescent lamps. Radiant heat which comes from a lighting unit or is re-radiated from the walls or ceiling is instantaneously effective in producing a feeling of warmth. And this is considerably more noticeable from a filament lighting system than from equal footcandles of fluorescent lighting. Its effect can be counteracted by maintaining a lower air temperature in a building which is artificially cooled. However, not all of the radiant heat from the lamps becomes a load upon

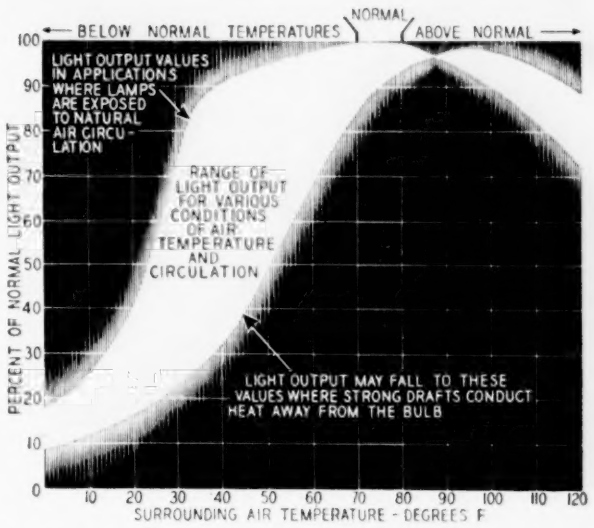
BELOW NORMAL TEMPERATURES
NORMAL
ABOVE NORMAL
LIGHT OUTPUT VALUES IN APPLICATIONS WHERE LAMPS ARE EXPOSED TO NATURAL AIR CIRCULATION
RANGE OF LIGHT OUTPUT FOR VARIOUS CONDITIONS OF AIR TEMPERATURE AND CIRCULATION
LIGHT OUTPUT MAY FALL TO THESE VALUES WHERE STRONG DRAFTS CONDUCT HEAT AWAY FROM THE BULB
PERCENT OF NORMAL LIGHT OUTPUT
100
90
80
70
60
50
40
30
20
10
0
10 20 30 40 50 60 70 80 90 100 110 120
SURROUNDING AIR TEMPERATURE - DEGREES F

Fig. 2. Effect of air drafts on light output of fluorescent lamps.

the lower sash of the windows and opening the transom over the door. For these tests the thermometers were the cooling system. A portion of it passes through the windows to the out-of-doors and some of it which strikes the walls, ceiling, and floor is absorbed by the building structure and is partially dissipated during the cooler night hours.

The ceiling height of the room has an important bearing upon this problem. The direct radiant heat from the lights will be much more noticeable in a low ceiling room because its effect varies inversely as the square of the distance of the human occupants from the heat source. Another effect of the ceiling height is due to stratification of the air. The sensible heat from the lamps causes the air surrounding the lamp to be heated and forms a stratum of very warm air near the ceiling. If this stratification is not disturbed by forced air currents, it will not affect the comfort of the occupants below, especially if the room has a high ceiling. If, however, the cooling system is designed to introduce the air at high velocity several feet above the floor, the stratification is disturbed and the lighting fixtures are swept by the currents of incoming cool air and their heat. This is absorbed by the incoming air to become a part of the load on the cooling system.

Lamp Wattage and Room Temperature

In order to investigate the relation between the temperature rise and the wattage capacity of the lighting system in a typical commercial office, a space was selected in an office building where the lighting capacity could be varied. This particular space has approximately 300 sq ft (17 ft by 17½ ft) of floor area with an 11¾ ft ceiling, and has two outside windows, each approximately 3 ft wide and 6½ ft high. The results of the investigation are shown in Fig. 3, curves *A* and *B*. Curve *A* represents the temperature rise for various wattage capacities of lighting when the room is closed as much as possible by keeping the windows and doors shut. Curve *B* represents the temperature rise on typical summer days when the office is ventilated by raising

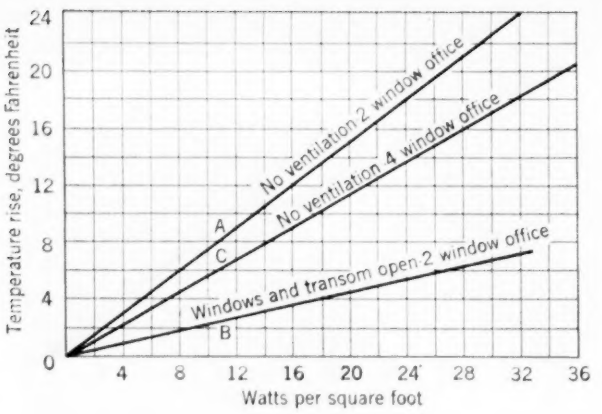

Fig. 3. Relation between temperature rise during a 7-hour period and wattage employed for lighting in two typical office spaces.

suspended in a vertical position near the center of the room with the bulbs 3 ft above the floor. Temperature readings were taken for a period of seven hours when a condition of equilibrium was being approached; that is, the heat dissipated from the room was nearly equal to the heat input and there was consequently but little further rise to be expected.

From the curves it will be observed that in the typical closed room with no artificial or natural ventilation, the temperature rise during the 7-hour period due to the lighting system is approximately $\frac{3}{4}$F for each watt per sq ft of electrical energy consumed (curve *A*). On the other hand, with the windows and the transom open for natural ventilation on typical summer days, the temperature rise is of the order of 0.22F for each watt per sq ft of lighting capacity (curve *B*). The lighting equipment consisted of four open-top, semi-indirect filament lamp units at the ceiling supplemented by indirect floor standards to provide the higher capacities.

Temperature readings in the test room were compared with those observed in an adjacent control room where no artificial lighting was used. The control room temperatures always remained practically constant during the test period. The rise in temperature in the test room was taken as the difference between its initial and final readings, and then this difference was corrected with any change which may have taken place in the control room.

For general lighting throughout many air-cooled interiors, the wattage capacity of the lamps will average from 2 to 4 watts per sq ft. However, some stores and offices may have as high as 8 to 10 watts per sq ft in use. From Fig. 3, it is interesting to note that with 4 watts per sq ft in a closed room, the temperature rise is 3F, and in a ventilated room during the summer time it is only about one degree. These temperature rises are so small that for uncooled buildings, little notice has been given to the heat generated by the artificial lighting system, and this is particularly true when fluorescent lamps are used.

A few typical examples of the relative importance of the several items which constitute the cooling load in different kinds of buildings are shown in Table 1. These are values which were calculated in the process of designing the cooling systems. The first installation in the table is a lunch room in which all the cooking as well as the serving is done. Therefore, the ranges and infiltration of outside air contribute most of the heat with only a very small percentage coming from the artificial lighting. Likewise, in convention halls, theaters, and auditoriums, the lighting system would normally con-

TABLE 1—RELATIVE IMPORTANCE OF FACTORS AFFECTING THE COOLING LOAD IN DIFFERENT CLASSES OF INTERIORS

Type of Interior	Lighting Load, Watts per Sq Ft	Relative Factors in Per Cent of Cooling Load					
		Artificial Lighting	Solar Radiation Through Windows	Heat Conducted Through Walls and Windows	Infiltration of Outside Air	Occupants	Electric Equipment Other than Lamps
Lunch Room	4.6	2	0	7	30	10	51
Coffee Shop	3.2	15	0	13	22	29	21
Restaurant	2	7	0	17	33	34	9
Dining Room	1.2	4	0	18	29	30	19
Cocktail Lounge	1	5	0	29	32	34	
*Apparel Stores	5.1	30	0	36	17	17	
Small Store	9.4	33	19	23	11	14	
Dept. Store	1.7	15	0	36	25	17	7
Bank	1	6	24	36	17	17	
Convention Hall	2.0	13	0	7	29	51	
Theater	0.7	5	0	5	45	45	
Large Office	1.5	16	34	29	12	9	
**General Office	4.4	25	0	45	20	10	
Office Building							
With Awnings	3.1	37	0	11	37	15	
Without Awnings	3.1	26	33	4	26	11	

*Average of 3 Stores. **Average of 2 Offices.

tribute only a small portion of the total heat, most of which comes from the assembly of people and the infiltration of outside air. On the other hand, the small store with its high level illumination has a cooling system using ⅓ of its tonnage capacity to absorb the heat from the lighting equipment. Also, in the office, the lighting load is a factor of considerable concern. A knowledge of the footcandles requirements for lighting both the store and the office is essential to the design of the cooling system because inadequate illumination with the lower computed capacity cooling requirements may eventually result in the dissatisfaction of both. Every effort should, however, be made to employ the most efficient type of lighting equipment which is of a design suitable for the interior and thereby reduce the lighting load to a satisfactory minimum.

The last building in Table 1 is one which has fairly large windows, a greater portion of which on all four sides are exposed to the sky. The percentage factors for the contributing heat sources are shown both with and without awnings on the windows. This illustrates how natural daylight and the radiant energy accompanying it affect the percentage factors and of course the overall design of the cooling system requires greater capacity when awnings are not used on such buildings.

The values in this table represent the maximum cooling load, which is used in selecting the size of the apparatus. In most interiors it is of course true that, on the cooler days in summer, the load caused by the lighting, though no larger in absolute quantity, is a greater proportion of the total. The figures referring to the lamps are based on the assumption ordinarily made that the entire heat equivalent of the energy input to the lamps, which are assumed to be actually in use, becomes part of the cooling load. Therefore, these values show the maximum effect of the lighting on the cooling system. It may then be concluded that the lighting is responsible for a part of the cooling load varying from a small amount up to 35 to 40% of the total, depending upon the type of building and occupancy. Recognizing this fact, thought has been given to ways of eliminating the heating effect from lighting units in some manner such as having the heat diverted directly from the source into a ventilating duct where it will be dispensed with or utilized as may be desired.

Heat Resisting and Heat Absorbing Media

It is generally known that water will readily absorb practically all the long-wave infrared radiation, that is, wave lengths longer than 1.4 to 1.6μ (microns). On the other hand, water transmits a high percentage of the energy appearing in wave lengths shorter than 1.0 to 1.2μ which includes the visible energy. Fig. 4 shows the relative energy at different wave lengths as generated by a 500-watt gas-filled incandescent lamp. Superimposed on this curve is a transmission curve for energy passing through 1 cm of distilled water. From this it is obvious that lighting units with cold water jackets instead of cold air would greatly facilitate the elimination of heat immediately at the light source. A light source adopting this feature was developed several years ago (2) and a design based on the original features has found practical application for the lens-type photographic enlargers. The

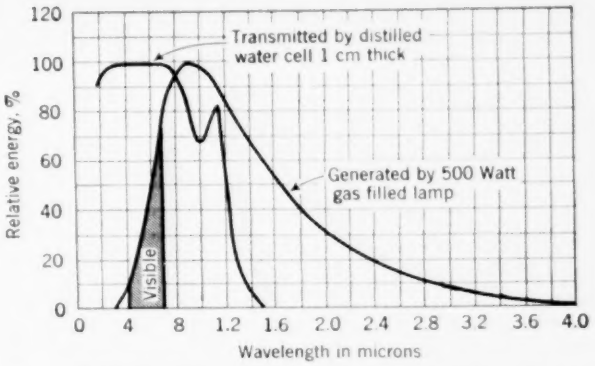

Fig. 4. Relative energy at different wave lengths from a 500-watt gas-filled incandescent lamp and per cent of this energy transmitted through 1 cm of distilled water.

unit consists of a distilled water jacket surrounding the lamp and a submerged coil through which cold water is continuously circulated. Tests on such a device employing a 1,500-watt projection type lamp indicate that 75% of the radiant energy is absorbed by the water while the sacrifice in total light output is only of the order of 20%. Although this method of dispersing the heat from an artificial lighting system is entirely practical under certain conditions, yet its general application for large interiors appears somewhat remote at the present time.

Another proposal for removing the radiation from the lighting system is to use cooling panels as suggested by C. S. Leopold(3) and by Merl Baker(4). In his work Mr. Baker developed a theoretical analysis of the removal of internal radiation from which he makes the following observations:

(1) That all of the lighting load need not be considered in calculating the cooling capacity required for convective cooling. In the absence of cooling panels, the value to be considered varies from approximately 96% for a very well insulated enclosure to approximately 68% for a very poorly insulated one.

(2) With a cooling panel absorptivity of 0.5 and 0.8 and assuming the panel intercepts one-half of the radiation from the light sources, the panel will absorp approximately 23 and 37%, respectively, of the total lighting watts. This conclusion is based on the further assumption that the enclosure surfaces possess an absorptivity of 0.5.

The walls and ceiling in a room, we have learned(5), may be finished with a heat-absorbing, light-reflecting paint which will reduce the internal radiation. The published information regarding this special paint indicates that it will reflect 75% of the light which corresponds to that of many of the creams, tans and nearly-white paints and at the same time it reflects only 30% of the total radiant energy striking it from a filament lamp.

For lighting systems of the totally-indirect design which depend upon the ceiling to distribute light throughout the room, a reduction in the reflected radiant energy is a worthwhile contribution toward greater comfort for the occupants of the room. Another somewhat similar medium for absorbing radiant energy from incandescent lamps has been developed(2) in a heat-resisting, heat-absorbing glass having a 2-millimeter thickness which will absorb 79% of the total energy generated from a 500-watt projection lamp. The light transmission of this

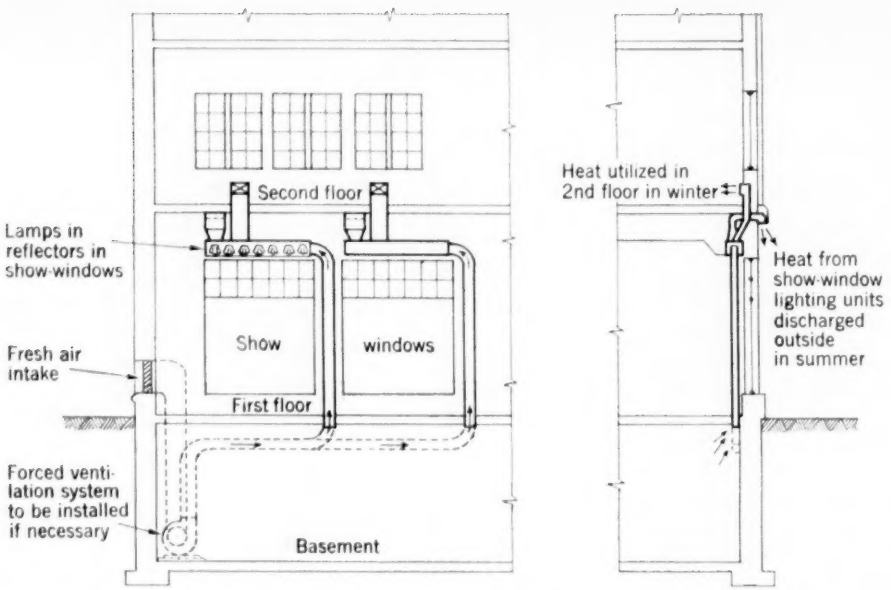

Fig. 5. Ventilating system for show window lighting which utilizes the heat in winter and dispenses it in summer.

special glass is still maintained fairly high, being approximately 75%. Plates of this glass are available for use in false ceilings above which artificial lighting systems can be installed. With such a system, a circulation of air could be produced to cool the glass plates and thereby to provide a method of eliminating a high percentage of the radiant energy from a lighting system before that energy is set free in an interior.

Of all the discussed methods of absorbing and eliminating heat from artificial lighting systems, the two most used are (1) air ventilating ducts, and (2) heat-resisting, heat-absorbing glass for built-in lighting, and this is often equipped with air ventilating ducts.

An example of the removal of heat by air circulation is illustrated in Fig. 5. This installation was made in the sales office of an electrical utility company having high level window lighting in which the windows are not partitioned off from the sales space as is often the case. The heat generated by the lamps was such a high percentage of the total heat that it became a considerable factor in the cost of the cooling system and also in its operation.

The lighting units are enclosed in metal boxes, each of which has a duct which supplies cool air drawn from the basement. The warm air is discharged to the out-of-doors during the summer when the artificial cooling system is in use. In winter, by a change of dampers, the heat is diverted to the second floor of the building where it is utilized for part of the heating requirements. Means are provided for installing a circulating fan but the gravity circulation alone appears to be sufficient. This installation was made partly for economic reasons in view of the cost of summer cooling, and partly to permit the operator better control of temperatures during the heating season.

In any room where warm air is displaced by cool air, it would seem logical to those who are inexperienced in the technique of air conditioning that the cool air should enter the room near the floor and the warm air be withdrawn at the ceiling. Quite the reverse is the modern cooling system which is designed to have the incoming air enter the room near the ceiling. This, of course, has certain advantages, the most important of which is the elimination of drafts and uncomfortably cool conditions for the occupants of the room.

The method of reheating the cold air to a comfortable temperature before it is released is a subject of much controversy. In general, the reheating is accomplished by mixing the dehumidified cold air with warm air which has either been bypassed around the cooling coils or which has been obtained from outdoors. In either case the volume of warm air must be sufficient to properly temper the air before it reaches the occupants of the room. In many cases at least a part of this tempering is accomplished by releasing the dehumidified cold air where an adequate amount of heat is absorbed.

Conclusions

From the foregoing tests and lighting energy analysis, the author makes the following conclusions:

(1) Radiant energy, which often causes at least as much discomfort and sometimes more than sensible heat, can be reduced to as little as one-fourth of that generated per footcandle by filament lamp by use of fluorescent lamps.

(2) Built-in lighting systems above heat-resisting glass plates, or totally-indirect luminaires below a radiant-energy absorbing special painted ceiling, or with a cooling panel ceiling can be very effective in removing a high percentage of the radiant energy which might otherwise cause some discomfort to the room occupants. A high percentage of the heat, however, from these energy-absorbing media will eventually become a load on the cooling system unless it becomes practical to install ventilating ducts to dispose of the heat.

(3) Tests with the filament lamp in an enclosing globe indicate conclusively that an air duct system for removing energy will take away only that portion of it which is dissipated by conduction and convection. This amounts to about one-third of the total energy generated by a filament lamp and a little over half of that from a fluorescent luminaire. Laboratory tests, however, indicate that extreme care must be taken in using air drafts

with fluorescent equipment because reduced light output may result.

(4) In some cases it is entirely practical to utilize some of the heat generated by the lighting system to temper the cold air for an air conditioning system. This has been used where artificial lighting is required all of the time the room is occupied, and particularly in high ceiling areas.

(5) There are many variable conditions which affect the absorption and dissipation of energy from artificial lighting systems. When all of these are considered in a building where none of the generated energy is carried off by a ventilating system, it is estimated that from 50 to 90% of it will eventually become a part of the cooling load. This, therefore, provides a small safety factor in the computation for designing an air cooled system which is usually based on the assumption that the heat equivalent from all of the lighting watts in use becomes a load on the cooling system.

(6) Before installing elaborate systems of ventilation ducts of built in heat-resisting heat-absorbing glass panels or cooling panels, one must estimate the optimum amount of heat that can be removed by any one of them. The economics of their use can then be compared with the cost of refrigeration to absorb an equal amount of heat. In many instances in the past, experience has shown the cost of refrigeration to be less. Furthermore, in northern latitudes the removal of heat from the lighting system is a problem for only three or four months throughout the year. During the other eight or nine months, this heat may be of some value in supplementing the heating system for the building.

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Appendix — Illumination Design Procedure

Lighting systems may be divided into two classes—general and supplementary. The general system supplies uniform illumination in the area; supplementary lighting supplies illumination of a specific nature, color, or distribution, usually to satisfy a local, specific requirement. Supplementary systems augment the general lighting system, often supplying hundreds of footcandles for certain tasks, machines, or displays.

Other terms for combinations of these are often used. Localized general lighting, for example, is a system designed so that rows of work benches, machines or sales counters receive emphasis by spacing the general luminaires with respect to them.

Footcandle calculations for supplementary lighting systems are discussed in the section entitled Point-by-Point Method.

General lighting design is merely a procedure which allows one to predetermine the lumens per square foot (footcandles) delivered to a horizontal work plane corresponding to the floor area. Conversely, knowing the footcandles desired (lumens per square foot) the problem is to account for losses due to room proportions, reflectivity of walls and ceiling, and fixture efficiency and light distribution, so that the total lumens that must be generated by the lamps can be computed. The procedure is the same regardless of the type of lamp used. The accompanying tables take these factors into account.

Table 2 shows the recommended footcandle levels maintained in service in practical installations.

Choice of Luminaire

Luminaires shown in Table 3 are typical of the various designs made by equipment manufacturers. These range

TABLE 2—TYPICAL GROUP OF INTERIORS WITH RECOMMENDED ILLUMINATION LEVELS

Type of Occupancy	Recommended Footcandles
Auditorium	
Assembly only	10
Exhibitions	30
Banks	
Lobby	20
Cases and offices	50
Barber Shop and Beauty Parlor	50
Bowling	
Alley runway	10-20
Pins	30-50
Billiards	
General	10
Tables	30-50
Club and Lodge Rooms	
Lounge and reading	20
Auditorium	10
Court Rooms	20
Dance Halls (with no color or spectacular effects)	5
Drafting Rooms	70
Hotels	
Lobby (with no provision for convention exhibits)	20
Dining room	5
Kitchen	30
Bedrooms—supplementary lighting	30
Corridors	5
Writing room—supplementary lighting	30
Library	
Reading rooms and stack room	30
Research study areas	50

TABLE 2 (CONTINUED)

Type of Occupancy	Recommended Footcandles
Theaters and Motion Pictures Houses	
During intermission	5
During pictures	0.1
Foyer	10
Lobby	20
Museum	
General	10
Special exhibits—supplementary lighting	50-100
Office Buildings	
Private and general office	
No close work	30
Close work	50
Conference rooms	30
Filing and mail sorting	30
Reception rooms	20
Corridors	5
Stairways	10
Post Office	
Lobby	30
Sorting, mailing, etc.	50
File room and vault	30
Corridors	5
Professional Offices	
Waiting rooms	20
Consultation rooms	30
Examination room	50-100
Dental chairs	50-200
Restaurants, Lunch Rooms and Cafeterias	
Dining area	10-50
Food displays	50
Kitchens	30
Stores	
Circulating areas	20
General merchandising areas	50
Show cases, wall cases and open counter displays	100
Feature displays	200
Stock rooms	10
Show Windows	
Cities—secondary business districts and small towns	
General	100
Feature displays	200
Cities—main business areas	
General	200
Feature displays	500
Minimizing daylight reflections	1000
Studios	
Broadcasting	50
Commercial photography	
General	20
Film exposures	200-500
Portrait photography	
General	20
Film exposures	100-200
Television	
General	20
On televised area	100
Color television	500

from direct lighting to totally indirect with many intermediate types—the proportion of upward and downward light being given by the percentage figures. The choice of a luminaire will depend upon its suitability to the interior, its design and appearance with due regard for its efficiency, and comfort as far as direct and reflected glare is concerned. Ease of maintenance is also an important factor.

Mounting Height and Spacing Distance

In order to get fairly uniform illumination over an area, the maximum spacing between units, as shown in Table 4, should not be exceeded. Closer spacing to conform to bays and other building construction features is quite often necessary. Downlights and similar concentrating reflectors require close spacing, depending on the degree of light concentration. The actual spacing for different types can be best worked out by the point-by-point method using the candlepower distribution curve for the specific unit under consideration.

Where continuous rows of units such as fluorescent troffers are used, the figures apply to the spacing between rows. However, with individual fluorescent equipments, where the lumen output is limited, conventional spacing distances cannot be used. The problem then becomes one of first figuring out the number of fixtures required to deliver the necessary lumens, and then planning the layout to accommodate this number of units.

Fluorescent lighting, particularly with flush mounted troffers, and ceiling mounted luminaires permits architectural layout in the form of continuous or broken lines, square or angular patterns as best suited to the interior. Coves and cornice lighting may also be employed effectively.

In many cases where desks, display or workbenches are next to walls, the normal drop in illumination at these areas can be brought up to average or above by the use of additional units or equipment accommodating more lamps above this area.

Room Proportions

Table 5 classifies rooms according to width, length and height of light source. For indirect and semi-indirect luminaires use the ceiling height. Determine the room index and apply it in Table 3 which lists the utilization coefficients.

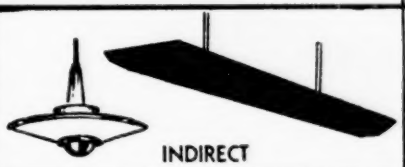
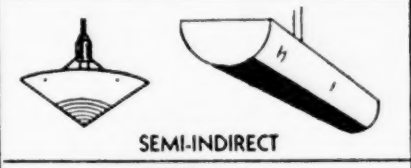
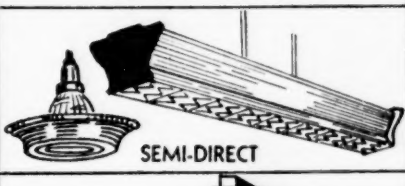
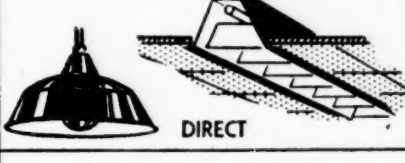
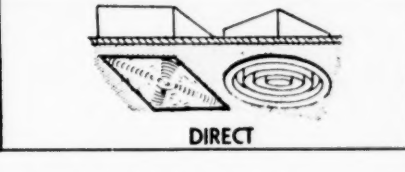
Utilization of Coefficients

Table 3 brings together all of the factors that affect the utilization of light. The figure obtained by reference to this table (for the type of fixtures used, the room index and the reflectivity of the walls and ceiling in which these are to be installed) is the percentage of the lumens given out by the lamps that reaches the working plane. For example, a utilization of 0.40 means that 40% of the light is useful in producing footcandles and that 60% is absorbed by the walls, ceiling and the fixture itself.

Luminaire Efficiency and Light Distribution

Utilization coefficients are calculated for the specific outputs and distributions and the sketches of fixture types merely help identify units which may fall into each class. Several luminaires may look about the same but differ considerably in efficiency and light distribution. Space does not permit publishing data on all the specific luminaires on the market, but if actual performance data on a specific luminaire are available, the range of data published is sufficient for the designer to make acceptable allowances for any departures.

TABLE 3—COEFFICIENTS OF UTILIZATION

TYPICAL DISTRIBUTION	LUMINAIRES	ROOM INDEX	REFLECTION FACTOR FOR CEILING, %					
			75			50		
			REFLECTION FACTOR FOR WALLS, %					
			50	30	10	50	30	10
			COEFFICIENTS OF UTILIZATION					
↑ 80 / 0 ↓	 INDIRECT	I	.16	.12	.11	.10	.09	.07
		H	.20	.16	.14	.13	.11	.10
		G	.23	.20	.17	.15	.13	.11
		F	.27	.23	.20	.18	.15	.14
		E	.29	.25	.22	.20	.17	.15
		D	.33	.29	.26	.22	.19	.18
		C	.36	.32	.30	.24	.22	.20
		B	.39	.35	.32	.26	.23	.22
		A	.43	.40	.37	.28	.26	.25
			.45	.42	.39	.30	.28	.26
↑ 70 / 10 ↓	 SEMI-INDIRECT	I	.18	.14	.13	.13	.11	.09
		H	.23	.19	.17	.17	.14	.12
		G	.26	.22	.20	.19	.16	.14
		F	.30	.25	.22	.21	.19	.17
		E	.32	.28	.25	.24	.21	.19
		D	.36	.32	.29	.27	.23	.21
		C	.40	.35	.32	.29	.26	.24
		B	.42	.38	.35	.30	.28	.26
		A	.46	.42	.40	.33	.31	.29
			.48	.44	.42	.35	.32	.31
↑ 40 / 40 ↓	GENERAL DIFFUSING	I	.25	.21	.19	.22	.19	.17
		H	.31	.27	.25	.28	.24	.22
		G	.35	.31	.28	.31	.28	.26
		F	.39	.35	.32	.34	.31	.29
		E	.42	.38	.35	.36	.33	.31
		D	.46	.42	.39	.40	.37	.34
		C	.50	.45	.42	.43	.40	.37
		B	.52	.48	.44	.45	.45	.42
		A	.56	.51	.48	.48	.45	.42
			.58	.53	.50	.49	.46	.43
↑ 25 / 45 ↓	 SEMI-DIRECT	I	.24	.20	.18	.22	.19	.17
		H	.30	.26	.24	.27	.24	.22
		G	.33	.29	.27	.30	.27	.26
		F	.36	.33	.30	.33	.30	.28
		E	.39	.35	.32	.35	.32	.30
		D	.42	.39	.36	.38	.36	.33
		C	.45	.42	.39	.41	.38	.36
		B	.48	.44	.41	.43	.40	.38
		A	.50	.47	.44	.45	.42	.41
			.52	.49	.46	.47	.44	.42
↑ 0 / 65 ↓	 DIRECT	I	.32	.28	.25	.32	.28	.25
		H	.40	.36	.34	.39	.35	.33
		G	.43	.39	.37	.42	.39	.37
		F	.46	.43	.41	.45	.43	.41
		E	.48	.45	.43	.47	.45	.43
		D	.52	.50	.48	.51	.49	.47
		C	.56	.54	.52	.55	.53	.51
		B	.57	.55	.53	.56	.54	.52
		A	.60	.58	.56	.59	.57	.55
			.61	.59	.57	.60	.58	.57
↑ 0 / 55 ↓	 DIRECT	I	.32	.30	.29	.31	.30	.29
		H	.38	.36	.36	.37	.36	.35
		G	.40	.40	.39	.40	.39	.38
		F	.43	.43	.42	.42	.41	.41
		E	.45	.44	.43	.43	.43	.42
		D	.47	.46	.46	.46	.46	.45
		C	.50	.48	.47	.48	.47	.47
		B	.51	.49	.48	.49	.48	.47
		A	.51	.50	.49	.50	.49	.48
			.52	.51	.50	.51	.50	.49

Initial Footcandles vs Footcandles Maintained in Service

Initial footcandles measured when lamps are new and when the equipment is clean will be higher than the average maintained in service. A maintenance factor (MF), therefore, is used in illumination calculations in order to make adequate allowance for the losses of light due to the usual collection of dust and dirt on lamps, luminaires, walls and ceilings, as well as the depreciation in lumen output throughout the life of the lamp. The magnitude of the maintenance factor varies with equipment design and conditions in the room interior. In general, it ranges from 0.60 to 0.70 with the higher value assigned to those units of such design that they are less likely to accumulate dirt. Hence a factor of 0.70 is used for direct types of luminaries; 0.65 to 0.70 for semi-direct; and 0.60 for indirect types. These values are based on the assumption that luminaires are cleaned reasonably often so that no great amount of dust will be allowed to collect.

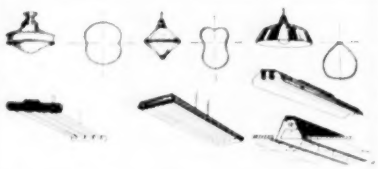
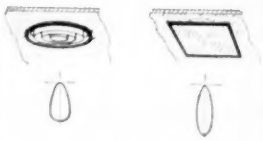
Computations

The lamp lumens required to light a room are computed from the formulas—

$$\text{Lamp lumens required} = \frac{\text{Footcandles (FC)} \times \text{area of room (sq ft)}}{\text{Utilization coefficient (UC)} \times \text{Maintenance factor (MF)}} \quad \text{(a)}$$

$$\text{Lamp lumens per luminaire} = \frac{\text{Total lumens required}}{\text{Number of luminaires to be installed}} \quad \text{(b)}$$

TABLE 4—SPACE-MOUNTING HEIGHT OF LUMINAIRES

General Diffusing	Semi-Direct	Direct	Semi-Concentrating Direct ★★★	Concentrating Direct ★★★	Indirect			Semi-Indirect
								
Mounting Height of Luminaire	Distance★ from Walls	Maximum★★ Spacing of Luminaires	Maximum★★ Spacing of Luminaires	Maximum★★ Spacing of Luminaires	Ceiling Height	Distance★ from Walls	Length of Suspension	Maximum★★ Spacing of Luminaires
7	3	7½	5½	2½	8	3	1–3	9
7	3	9	6	3	9	3	1½–3	10½
8	3½	10½	7	4	10	3½	2–3	12½
9	3½	12	8	4½	11	3½		13½
10	4	13½	9	5	12	4	2½–4	15
11	4	15	10	5½	13	4	3–4	17
12	5	16½	11	6	14	5		19
12	5	18	12	6½	15	5		20
12	6	20	13	7	16	6	4–5	22
14	6	22	15½	8	18	6		24
16 or more	7	25	17½	9	20 or More	7	4–6	28

All dimensions in feet.

★ These spacings apply where desks and benches are next to wall, otherwise one-half the spacing between units is satisfactory.

★★ The actual spacing of luminaires is usually less than the Maximum Spacing to suit bay or room dimensions, or to provide adequate illumination.

★★★ Ceiling mounted.

In planning a lighting system where it is desired to install a specified type of luminaire in which one or more lamps are employed as is often the case for a fluorescent system, the form of equation (b) can be changed to:—

$$\text{Number of luminaires} = \frac{\text{Total lumens required}}{\text{Lamp lumens per luminaire}} \quad \text{(c)}$$

Lumens of light generated by sizes and types of lamps most generally used are given in Table 6.

Typical Example of General Lighting Design Procedure

Suppose we were to plan the lighting for a drafting room which has a work area of 36 ft × 130 ft with a 10 ft ceiling which is painted white (75% reflection) and with medium colored side walls (30% reflection). The procedure would be as follows:

(1) *Illumination*—The illumination requirements for a drafting room is 70 footcandles as shown in Table 2.

(2) *Choice of Luminaire*—There are several designs of lighting units which would meet the requirements for detail work as carried on in a drafting room. One of the most satisfactory designs is a troffer type direct fluorescent unit as illustrated second from the bottom in Table 3. If a unit of this type is selected we might assume that it will be equipped with a 96-inch T-12 standard cool white lamp which consumes 74 watts plus 16 watts for the 2 lamp series ballast (a total of 90 watts) and generates 4,950 lumens of light. (See Table 6). The maintenance factor for a troffer type unit is assumed to be about 70%.

(3) *Mounting Height and Spacing Distance of Luminaires*—The correct location of the luminaire is necessary in order to insure a fairly even distribution of light. Table 4 indicates the maximum permissible distance between lighting units. For this particular interior having a ceiling height of 10 ft and using a troffer type unit mounted flush with the ceiling, the maximum spacing distance is 13½ ft. Although this maximum distance must be kept in mind when the actual spacing of luminaires is determined it is quite evident that a much closer spacing will be required to provide 70 footcandles if each unit generates only 4,950 lumens.

(4) *Room Proportions*—From Table 5 we find that if a direct type of unit is installed in a room 36 ft × 130 ft with units mounted 10 ft above the floor the room index is *C*.

(5) *Utilization Coefficient*—By making use of the foregoing information we can now turn to Table 3 where we find that if troffer type luminaires are installed in a room having an Index of *C*, with a 75% ceiling and 30% walls the utilization coefficient is 55%.

(6) *Computations*—We now have sufficient data to solve equation (a) as follows:

$$\text{Lamp lumens required} = \frac{70 \text{ Ft C} \times (36 \times 130) \text{ sq ft}}{0.55 \text{ (UC)} \times 0.70 \text{ (MF)}} = 850{,}000 \text{ Lumens}$$

Since each luminaire generates 4,950 lumens (Item 2)

$$\text{the number of luminaires} = \frac{850{,}000}{4{,}950} = 172$$

TABLE 5—ROOM INDEXES

CEILING HEIGHT—FEET

For Semi-Indirect and Indirect	9 and 9½	10 to 11½	12 to 13½	14 to 16½	17 to 20	21 to 24	25 to 30	31 to 36	37 to 50		

MOUNTING HEIGHT ABOVE FLOOR—FEET

For Direct; General Diffusing and Semi-Direct		7 and 7½	8 and 8½	9 and 9½	10 to 11½	12 to 13½	14 to 16½	17 to 20	21 to 24	25 to 30	31 to 36	37 to 50
Room Width (Feet)	Room Length (Feet)	ROOM INDEX										
9 (8½–9)	8-10	H	I	J	J							
	10-14	H	I	I	J							
	14-20	G	H	I	J	J						
	20-30	G	G	H	I	J	J					
	30-42	F	G	H	I	J	J	J				
	42-up	E	F	G	H	I	J	J				
10 (9½–10½)	10-14	G	H	I	J	J						
	14-20	G	H	I	J	J	J					
	20-30	F	G	H	I	J	J					
	30-42	F	G	G	H	I	J	J				
	42-60	E	F	G	H	I	J	J				
	60-up	E	F	F	H	H	I	J				
12 (11–12½)	10-14	G	H	I	I	J	J					
	14-20	F	G	H	I	J	J					
	20-30	F	G	G	H	I	J	J				
	30-42	E	F	G	H	I	J	J				
	42-60	E	F	F	G	H	I	J				
	60-up	E	E	F	G	H	I	J				
14 (13–15½)	14-20	F	G	H	H	I	J	J				
	20-30	E	F	G	H	I	J	J				
	30-42	E	F	F	G	H	I	J	J			
	42-60	E	E	F	F	H	I	J	J	J		
	60-90	D	E	E	F	G	H	J	J	J		
	90-up	D	E	E	F	F	G	I	J	J		
17 (16–18½)	14-20	E	F	G	H	I	J	J				
	20-30	E	F	F	G	H	I	J				
	30-42	D	E	F	G	H	H	J	J	J		
	42-60	D	E	E	F	G	G	I	J	J	J	
	60-110	D	E	E	F	G	G	I	J	J	J	
	110-up	C	D	E	E	F	G	H	I	J	J	
20 (19–21½)	20-30	D	E	F	G	H	I	J	J			
	30-42	D	E	E	F	G	H	I	J	J		
	42-60	D	D	E	E	F	G	I	J	J	J	
	60-90	C	D	E	E	F	G	H	J	J	J	
	90-140	C	D	D	E	F	F	H	I	I	J	J
	140-up	C	D	D	E	F	F	H	H	I	J	J
24 (22–26)	20-30	D	E	E	F	G	H	I	J	J		
	30-42	C	D	E	F	G	G	I	J	J		
	42-60	C	D	D	E	F	G	H	I	J	J	
	60-90	C	D	D	E	F	F	H	I	J	J	J
	90-140	C	C	D	E	E	F	G	H	I	J	J
	140-up	C	C	D	E	E	F	G	H	I	I	J
30 (27–33)	30-42	C	D	D	E	F	G	H	I	J	J	
	42-60	C	C	D	D	F	F	H	H	I	J	
	60-90	B	C	C	D	E	F	G	H	I	J	J
	90-140	B	C	C	D	E	E	F	G	H	I	J
	140-180	B	C	C	D	E	E	F	G	H	I	J
	180-up	B	C	C	D	E	E	F	G	H	I	J
36 (34–39)	30-42	B	C	D	E	F	F	H	I	I	J	
	42-60	B	C	C	D	E	F	G	H	I	J	J
	60-90	A	C	C	C	E	E	F	H	H	J	J
	90-140	A	B	C	C	D	E	F	G	H	I	J
	140-200	A	B	C	C	D	E	F	F	G	H	I
	200-up	A	B	C	C	D	E	F	F	G	H	I
42 (40–45)	42-60	A	B	C	C	E	F	G	H	I	I	J
	60-90	A	B	B	C	D	E	F	G	H	I	J
	90-140	A	B	B	C	D	D	E	F	G	H	J
	140-200	A	A	B	C	D	D	E	F	G	H	I
	200-up	A	A	B	C	D	D	E	F	F	G	I
50 (46–55)	42-60	A	A	B	C	D	E	F	G	H	I	J
	60-90	A	A	B	C	C	D	F	F	G	H	J
	90-140	A	A	A	C	C	D	E	F	F	G	I
	140-200	A	A	A	C	C	D	E	E	F	G	I
	200-up	A	A	A	C	C	D	E	E	F	G	H
60 (56–67)	60-90	A	A	A	B	C	D	E	F	G	H	I
	90-140	A	A	A	B	C	C	D	E	F	G	H
	140-200	A	A	A	B	C	C	D	E	E	F	H
	200-up	A	A	A	B	C	C	D	E	E	F	H
75 (68–90)	60-90	A	A	A	A	B	C	D	E	F	G	I
	90-140	A	A	A	A	B	C	D	E	F	F	H
	140-200	A	A	A	A	B	B	C	D	E	F	G
	200-up	A	A	A	A	B	B	C	D	E	F	G

Rooms of dimensions greater than those included in table can be reduced to equivalent smaller rooms by dividing each of the principal dimensions by the same number. The room indexes are then obtained as shown in the following examples:

1. If semi-indirect or indirect lighting is to be used in an auditorium 120 ft x 300 ft with a 27 ft ceiling (24 ft above work-plane), an equivalent smaller room would be 40 ft x 100 ft x 8 ft (above work-plane) or 40 ft x 100 ft x 11 ft (ceiling). Room index B.

2. If direct lighting units are to be used in an industrial plant, 200 ft x 600 ft with a 48 ft mounting height (45 ft above work-plane), an equivalent smaller room would be 40 ft x 120 ft x 9 ft (above work-plane) or 40 ft x 120 ft x 12 ft (mounting height). Room index D.

TABLE 6—LUMEN OUTPUT OF LAMPS

Incandescent Lamps			Mercury Lamps			
Watts	Fila. Lumens 120-volt	230-volt	Lamp	Lums.	Lamp	Lums.
200	3700	3000	H400-A1	15000	H1000-A1	52000
300	5650	4850	H400-E1	20000	H3000-A9	120,000
500	9900	8850				
500R-52	9000	....	Fluorescent Lamps			
750	15600	14200	Lamp	Lumens Warm White	Cool White	
750R-52	14200	....	40-w	2500	2350	
1000	21500	19500	90 and 100-w	5150	4850	
1500	33000	....	96" T-8 120 ma	2350	2250	
			96" T-8 200 ma	3450	3300	
			96" T-8 300 ma	4500	4300	
			96" T-12 425 ma	4950	4800	

These 172 luminaires can be arranged in different patterns, depending upon whether there is any advantage in having continuous rows lengthwise or crosswise of the room. A suggested plan would be to install rows of luminaires crosswise of the room and since each unit is a little over 8 ft long, 96-inch lamps being used, we can install only 4 of them, end to end, in the 36 ft width. Then it follows that there must be $\frac{172}{4}$ or 43 rows.

Since the room is 130 ft long, the rows of units will be spaced $\frac{130}{43}$ or on 3 ft center. It should be noted that troffer type units are designed to have a width of 12 inches so that they can be readily installed in ceilings equipped with materials which are regularly manufactured in standard widths of 12 inches or multiples of it.

The recommended lighting installation would, therefore, be 43 rows or single lamp 96 T-12 troffer units with 4 luminaires per row in order to provide 70 footcandles average in service. This installation would have a total connected load of 172 units of 90 watts each or 15.48 kilowatts.

Point-by-Point Method of Calculation

The point-by-point method of lighting calculation is employed for single luminaires such as used for supplementary lighting over workbenches, or when special types of equipment not commonly adapted for general lighting systems are specified. The system facilitates making quick estimates of footcandle results in the application of auxiliary spotlights and floodlights. This method is based on the application of the inverse square law to data obtained from the candlepower distribution curve of the luminaire. The footcandles are computed by use of one of the three following formulas, depending on the point location.

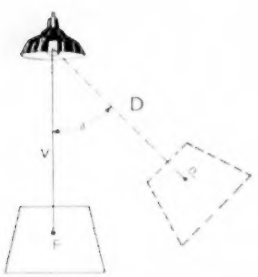


Fig. 6

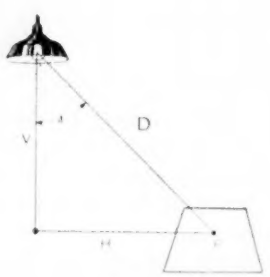


Fig. 7

When the point is in a plane normal to the beam, Fig. 6, the formula is:

$$\text{Footcandles} = \frac{\text{CP (candlepower)}}{\text{V}^2 \text{ (distance in feet)}}$$

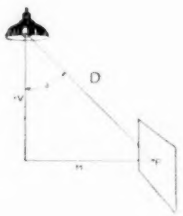
When the point is on a horizontal plane at a distance H, Fig. 7, the formula is:

$$\text{Horizontal footcandles} = \frac{\text{CP} \times \text{cosine of angle a}}{(\text{V}^2 + \text{H}^2)}$$

$V^2 + H^2$ is equal to D^2; D is the distance from the source to the point P. (Note: When

$$H = 0, \cos = 1.0, \text{ and Ft-c} = \frac{CP}{V^2} \text{ as in Fig. 6)}$$

Fig. 8



When the point is on a vertical plane, Fig. 8, the formula is:

$$\text{Vertical footcandles} = \frac{\text{CP} \times \cos (90° - \text{a})}{(\text{V}^2 + \text{H}^2)}$$

These formulas can be utilized in the calculation of the distribution of ultra-violet energy from sunlamp systems and of germicidal installations.

Further Comments on Lighting Design

A careful study should be made of Table 3 showing coefficients of utilization for a group of luminaires which provide different light distributions. In cases where two or more of them appear to satisfy the requirements from a quality viewpoint, it would be most desirable from an air cooling viewpoint to select the unit having the highest utilization coefficient. For example, it has been good practice for many years to use indirect or semi-indirect equipments in the well lighted office and such designs will continue to have wide application. However, recent designs of a fluorescent troffer direct type unit, as illustrated by the second unit from the bottom of Table 3, has proven to be quite satisfactory for comfortable lighting in many offices and it has the advantage of a high utilization, which should be considered in an air cooled space. Moreover, one should not overlook the fact that the utilization coefficient is higher when the side walls and ceiling redirect a higher percentage of the light toward the desk tops, work benches, store counters and other work areas. These are all controllable factors which enter into the economics of air cooling and artificially lighting a room.

Preview of Events at Chicago

The 11th International Heating and Ventilating Exposition will be held at the International Amphitheatre, Chicago, Ill., January 26-30, in conjunction with the 59th annual meeting of the American Society of Heating and Ventilating Engineers at the Conrad Hilton Hotel January 26 to 29. Following are facts about and list of exhibitors at the exposition and the program planned for the convention.

Exhibitors at the 11th International Heating and Ventilating Exposition

Booth numbers preceded by (2-) are on 2nd floor.

Facts about the Exposition

Title: The 11th International Heating and Ventilating Exposition.

Place: International Amphitheatre, Chicago, Illinois.

Time: Monday, January 26, 2 p.m. to 6 p.m.
Tuesday, January 27 through Thursday, January 29, inclusive, 12 noon to 10 p.m.
Friday, January 30, 12 noon to 6 p.m.

Audience: Admission is restricted to persons concerned with the design, purchase, installation, use and sale of heating, ventilating and air conditioning equipment and is controlled by invitation and registration.

Exhibitors: Booths will cover the entire first floor and arena and the north and south wings of the second floor.

Exhibitor	Space No.
A-J Mfg. Co.	906
A-P Controls Corp.	1107, 1109
Ace Engineering Co.	427
Acme Industries, Inc.	1134, 1136, 1138
Air Controls Products, Inc.	2-124
Air Controls, Inc., Div. of The Cleveland Heater Co.	442
Air Devices, Inc.	1310, 1312, 1314
Air-Maze Corp.	1211, 1213
Airtemp Div., Chrysler Corp.	734
Airtherm Mfg. Co.	1220
Aldrich Co.	424, 426
Allen-Bradley Co.	2-108, 2-112
Allis-Chalmers Mfg. Co.	516, 518
American Air Filter Co., Inc.	735, 737
American Artisan	425
American Blower Corp.	714
American Coils Co.	2-109, 2-213, 2-215
American District Steam Co., Inc.	2-236
American Furnace Co.	2-204
American Gilsonite Co.	2-530
American Hydrovac, Pump Div. of Pitz Foundry, Inc.	2-418, 2-420
American Iron and Steel Institute, Committee on Steel Pipe Research	924
American Radiator & Standard Sanitary Corp.	708, 815
American Society of Heating and Ventilating Engineers, The	905
American Society of Heating and Ventilating Engineers Research Laboratory	2-325
American Solvent Recovery Corp., Pur Air Div.	2-427, 2-429
Anchor Div., Stratton & Terstegge Co., Inc.	2-715, 2-717
Anderson Co., The V. D.	917, 919
Anemostat Corp. of America	614
Anthracite Institute	1309, 1311, 1315, 1317, 1321
Appleman Art Glass Works	2-238
April Showers Co., Inc.	2-314
Aqua-Solar Engineering, Div. Muellermist Irrigation Co.	2-314
Armstrong Furnace Co.	1301, 1302
Armstrong Machine Works	2-425
Armstrong Steam Trap Co.	2-425
Atlantic Pipebending & Fabricating Corp.	929
Atlantic Steel Boiler Co., Inc.	2-104
Auer Register Co., The	2-137
Au-Temp-Co. Corp.	908
Auto-Flo Corp.	2-341
Automatic Devices Co., Inc.	534
Automatic Firing Corp.	308, 310, 312, 314
Automatic Humidifier Co.	2-115
Avco Mfg. Corp., Crosley Div.	2-405
Axeman-Anderson Co.	1309, 1311, 1313, 1315, 1317
Bacharach Industrial Instrument Co.	1346
Bahnson Co., The	522, 524, 526
Baker Refrigeration Corp.	2-306, 2-308
Baldor Electric Co.	2-133
Baltimore Aircoil Co.	939
Barber-Colman Co.	508
Barkow Mfg. Co., Inc., Aug. G.	2-1012
Barnes & Jones, Inc.	1242
Belgian Electric Sales Corp.	2-313
Bell & Gossett Co.	1207, 1209
Bett-Marr Mfg. Co.	2-804
Beverly Shear Mfg. Co., The	2-307
Binks Mfg. Co.	2-125
Boiler Engineering & Supply Co., Inc.	2-141
Borg-Warner Corp., Norge Heat Div.	1033, 1035, 1037, 1039
Boston Machine Works Co.	2-140
Brown Products Co.	933, 935
Brundage Co., The	2-304
Brunner Mfg. Co.	2-209, 2-213, 2-215
Buffalo Forge Co.	201, 202
Builders-Providence, Inc., Div. of B.I.F. Industries	1344
Bundy Tubing Co.	1333, 1335
Burdette Mfg. Co.	2-903
Burgess-Manning Co., Architectural Products Div.	2-700
Burnham Corp., Boiler Div.	1036, 1038
Bush Mfg. Co.	126, 128
Carey Mfg. Co., Inc., The Philip	2-440
Carnes Company, W. R.	2-336
Carrier Corp.	227, 229, 231, 233
Carver Pump Co.	105
Century Electric Co.	1225
Century Engineering Corp.	827
Certified Furnace Co., Div. of Stainless & Steel Products Co.	2-105
Char-Gale Mfg. Co.	108, 110
Chase Company, W. M.	346
Chelsea Fan & Blower Co., Inc.	1006
Chicago Blower Corp.	1307
Chicago Pump Co.	835
Clarage Fan Co.	1028, 1030
Clayton & Lambert Mfg. Co.	2-240
Cleaver-Brooks	2-119, 2-121
Coal-O-Matic Co.	1309, 1311, 1313, 1315, 1317, 1321
Coleman Co., Inc., The	1106, 1108
Cole-Sewell Engineering Co.	103
Columbia Burner Co., The	230, 232
Combustion Control Corp.	538, 540
Combustioneer Div., The Steel Products Engineering Co.	1327, 1329, 1331
Commercial Filters Corp.	324
Conco Engineering Works Div., H. D. Conkey & Co.	916
Congress Drives Div., Tann Corp.	330
Connor Engineering Corp.	208, 210
Continental Air Filters, Inc.	112, 114
Coolerator Co., The	2-609
Copeland Refrigeration Corp.	843
Cory Corp.	2-918
Crane Co.	212, 214, 216, 220
Crise Controls Div., The Acro Mfg. Co.	2-510
Crosley Div., Avco Mfg. Corp.	2-405
Curtis Refrigerating Machine Div., Curtis Mfg. Co.	234, 236, 238, 335, 337, 339
Cutler-Hammer, Inc.	2-704, 2-708
Daffin Mfg. Co.	2-1010
Davidson Fan Co.	1126
Dayton Rubber Co., The	2-132
DeBothezat Fans Div., American Machine and Metals, Inc.	130, 132
Delavan Mfg. Co.	506
Delta Heating Corp.	2-1018

Old Timers' Get-Together

Members of the Old Timers' Club of the oil burner industry are invited to attend a get-together planned for the evening of Tuesday, January 27th, by the Midwest Old Timers' Club on top of the Furniture Mart. Tickets priced at $10 are available in advance from H. A. Maccubbin, 120 Madison Street, Villa Park, Ill. The affair is open to members only.

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PROGRAM OF 59th ANNUAL MEETING
AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

• The Conrad Hilton Hotel, Chicago, Ill. •

Monday — January 26

9:30 a.m. First Session

A Comparison of Physiological Adjustments of Clothed Women and Men to Sudden Changes in Environment, by Tohru Inouye, F. K. Hick, M.D., R. W. Keeton, M.D., J. Losch, Nathaniel Glickman

Two Methods of Calculating Friction Heads for Pipe Lines, by F. E. Giesecke

2:00 p.m. Exposition

Opening of 11th International Heating and Ventilating Exposition at the International Amphitheatre

Tuesday — January 27

9:30 a.m. Second Session

Compression Tank Sizing, by H. A. Lockhart and G. F. Carlson

The Bacteria and Odor Control Problem in Occupied Spaces, by R. L. Kuehner

Heat Transmitted to the I-B-R Research Home from the Inside Chimney, by W. S. Harris and R. J. Martin

Fuel Consumption Analysis for Multi-Family Housing Projects, by Rutcher Skagerberg and J. E. Phifer

2:30 p.m. Third Session

Participation by Colleges in Research, by E. A. Walker

Government Sponsored Research—A Canadian View, by R. F. Legget

Industrial Research in the Control of Environment, by W. H. Kliever

Wednesday — January 28

9:30 a.m. Fourth Session

Friction Losses in Round Aluminum Ducts, by F. W. Hutchinson

Pressure Losses in 4-Inch Diameter Galvanized Metal Duct and Fittings, by H. G. Conn, W. G. Colborne, and W. G. Brown

Pressure Loss Characteristics of Small Diameter Round, Duct Systems, by G. R. Whitnah and J. V. Borry

Room Air Distribution Research for the Improvement of Year-Round Air Conditioning—Part I, by S. F. Gilman, H. E. Straub, A. E. Hershey, R. B. Engdahl

2:30 p.m. Fifth Session

Report of Committee on Research, by I. W. Cotton

Field Studies of Floor Panel Control Systems, by A. B. Algren, E. F. Snyder, Jr., J. S. Locke

Heat Exchangers in a Ceiling-Panel-Heated Room, by L. F. Schutrum, G. V. Parmelee, C. M. Humphreys

The Shading of Sunlit Glass: An Experimental Study of Slat-Type Sun Shades, by G. V. Parmelee, W. W. Aubele, D. J. Vild

7:00 p.m. Annual Banquet (Grand Ballroom)

Presentation of F. Paul Anderson Medal

Thursday — January 29

9:30 a.m. Sixth Session

Maximum Downward Travel of Heated Jets from Standard Long Radius ASME Nozzles, by Linn Helander, Shee-Mang-Yen, R. E. Crank

Air Velocities in Ventilating Jets, by G. L. Tuve

Summer Cooling in Research Residence No. 2 at University of Illinois—1952, by H. T. Gilkey, D. R. Bahnfleth, R. W. Roose

Society Business

Resolutions

Installation of Officers

Adjournment

What Would You Do?

Replies to engineering and operating problems of interest to the industrial plant engineer

Conducted by
NATHAN N. WOLPERT
Associate Editor

WHILE other departments of this publication may be of general interest, this section is specifically planned for the industrial plant engineer. Here he may present his problems for general discussion, or perhaps draw on his experience in commenting on problems scheduled for these pages. Letters addressed to the Editor, are always welcome.

The current problem is a timely one and of wide interest. It deals with the question of knowing when to defrost cooling coils.

This Month's Problem

In connection with a storage room where we keep material until shipped, there is a question of how often the cooling coils should be defrosted. Is there any visible indication or simple mathematical approach that would indicate when it is time to defrost the cooling coils?

Answers to This Month's Problem

The frost that develops on coils in storage rooms must be periodically removed from the cooling surface for the following reasons:

The frost layer serves as an insulating blanket on the cooling surface so that it becomes necessary to lower the refrigerant temperature and use larger capacity refrigerating equipment for the same cooling duty.

The frost layer restricts the flow of air through the coil by reducing the free area available for air flow.

Because of the thermal resistance of the frost layer, the temperature of the surface in contact with the air is raised so that conditions in the refrigerated space are changed.

The frost layer adds to the weight of the coil and the load on the coil supports.

The lower refrigerant temperature necessary to produce the required refrigeration capacity increases the horsepower per ton of refrigeration produced.

The length of time between defrosting depends upon (1) allowable frost thickness and (2) rate of frost accumulation. Good engineering practice limits the allowable frost thickness on coils used with forced air circulation to ⅛ inch for bare pipe coils and to 1/16 inch for finned coils.

The rate of frost accumulation may be determined by the following formulas:

$$\text{Lb frost per hour} = \frac{\text{Latent tons} \times 12{,}000 \text{ Btu per hr per ton}}{1{,}200 \text{ Btu per lb moisture}} = \text{Latent tons} \times 10$$

Latent tons = Total tons − sensible tons

The following relationship determines the length of time between defrostings:

$$\text{Hours between defrostings} = \frac{C \times T \times 30}{D \times 12}$$

Where:

C = Square feet of bare pipe or finned coil.
T = Allowable frost thickness in inches; ⅛ inch for bare pipe and 1/16 inch for finned pipe.
D = pounds of frost deposited per hour or latent tons × 10.
12 = Conversion from frost thickness in inches to feet.
30 = Weight of frost in pounds per cubic foot.

George R. Wachter
Manager of Sales Engineering,
York Corp.
York, Pa.

It appears to us that the best index of excessive frost on cooling coils is a lower than normal operating suction pressure. For purposes of illustration, let us suppose that the operation of the compressor is controlled by a room thermostat and that liquid refrigerant is fed to the evaporator through a thermostatic expansion valve. The refrigerated room is to be held at 0F, and the coils have been correctly chosen for a 10F difference between saturated suction temperature and room temperature. Thus, the suction pressure which obtains for most of the running cycle is 4.5 psi, the pressure corresponding to −10F saturation for Freon 12. As the coil accumulates frost, a greater temperature difference is required to maintain the room at the desired temperature, causing the suction pressure to decrease.

The day-by-day history could be shown on the usual temperature and pressure recorder. The maintenance department could then be instructed to defrost the cooling

Problem for Coming Issue

February Issue

There are several methods used for welding stainless steel pipe for both shop and field work where the weld is to be made manually. Which do you consider the best method for such use? With the method recommended, are there any precautions to follow to insure a good weld?

coils when the average difference between storage room and refrigerant suction temperature increased to say 15F.

A. D. Sullivan
Chief Engineer,
Brunner Manufacturing Co.
Utica, N. Y.

There is no mathematical approach to the question of when it is time to defrost the cooling coils, for the variables entering into consideration are in themselves too uncertain. If the coils of a storage room are connected to a single condensing unit and the dry bulb and wet bulb temperatures of the room were constant, then a relation may be established between suction pressure and frost accumulation. Observations in this direction have shown that with accumulating frost, the suction pressure at first drops very slowly and then almost suddenly to a very low level. This sudden drop occurs when the frost begins to bridge the spaces between the fins. The most practical, and generally followed way, of course, is to observe the frost condition of the coil and to thaw the coil off before the frost has bridged the gaps between the fins.

H. J. Kipp
Engineering Department,
Curtis Refrigerating Machine Division of Curtis Manufacturing Co.
St. Louis, Mo.

"Hot" Laboratory Used for Atomic Study

Nuclear scientists, who work daily with radioactive materials too "hot" to handle, have been able to solve many of their problems by using what is labeled the Hot Laboratory, a development of the atomic age.

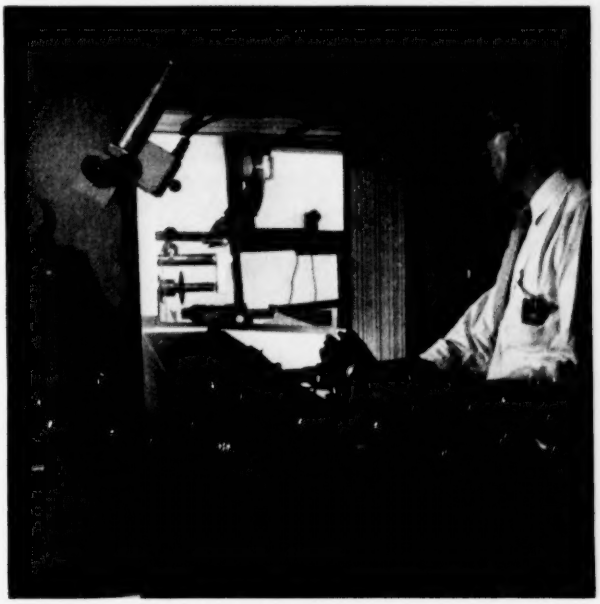
One such group of scientists is at work in the Bettis Plant, Pittsburgh, Pa., of the Atomic Energy Commission. This plant is operated by the Westinghouse Atomic Power Division, which is engaged in two of the nation's atomic projects—construction of the atomic power plant for the submarine U. S. S. Nautilus, and development of another nuclear reactor for a large vessel, such as an aircraft carrier. Both projects are being conducted for the U. S. Navy and also for the Atomic Energy Commission.

A major problem in the construction of nuclear reactors is that of handling radioactive materials during tests and laboratory analyses. For safety purposes, this testing is done almost completely by remote control in a building known as the Hot Laboratory.

There are five "hot spots," or cells, in this laboratory and these are separated from the main working area by a thick, concrete and lead wall. In the cells themselves—each separated from the other by a thick steel wall—are testing devices designed especially for the lab's operations.

The inside of each cell is viewed through a 36-inch thick window comprised of layers of plate glass separated by oil. Mechanical, claw-like hands, controlled from outside the cell, move radioactive objects into position for testing. A periscope-telescope arrangement enables scientists to examine specimens through a remotely controlled microscope.

One of the cells at the Atomic Power Division's Hot Laboratory. Remote control equipment prevents contact with material.



A specimen which has been subjected to radiation is being weighed on the Gram-atic Balance through remote control.

PRODUCT APPLICATIONS

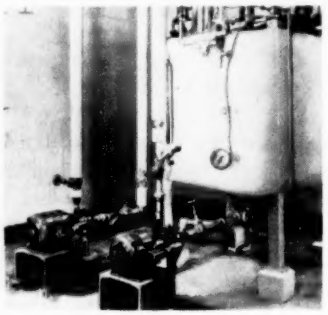
New, Unusual, or Ingenious Uses of Equipment and Materials

Conducted by WM. B. FOXHALL, Associate Editor

Pumps Handle Corrosive Slurry

PROBLEM: At the Corn Products Refining Co., Argo, Illinois, a water slurry of calcium carbonate had to be pumped from a cooker through plate and frame presses on the floor above. The slurry, which had a temperature reading between 160 and 180F and a pH of 9.5, caused three pumps to fail.

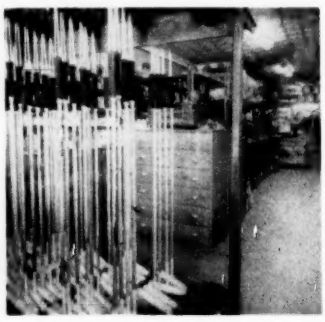
SOLUTION: Bell & Gossett engineers found that B & G Series 1522 centrifugal pumps were capable of handling the tough assignment. The necessary endurance provided by stainless steel parts in the pumps plus a unique mechanical seal in which a carbon seal operates against a fixed insert of remite, a new extremely hard material. Advantage of the seal is that it eliminates the need for water flushing. The pumps used in the project are ¾-inch with a 2-hp motor.



RESULTS: Failure of pumps by corrosive and abrasive action of the slurry has been reduced to a minimum. Since the primary object of the process is to remove water, elimination of flushing water is an advantage.

Polo Mallets Air Conditioned

PROBLEM: Gray's Saddlery in Westbury, L. I., is a specialty shop which fabricates mallets to meet the exacting requirements of the local Meadow Brook Club and other enthusiasts. Heads of the mallets are made from bamboo roots and their shafts are made from a special cane which grows only in the Malayan jungle. In former years, the wood was left to stand for a drying period of more than five years. Gray's developed a special drying kiln to speed up the manufacturing process, but due to high humidity conditions the dry wood was found to be reabsorbing moisture.



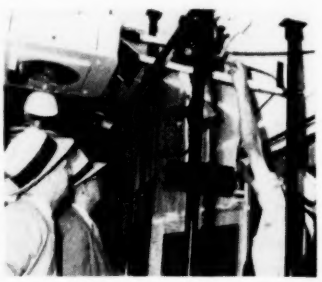
SOLUTION: Humidity control through air conditioning was provided by a 3-ton U. S. Air Conditioning Corp. upright conditioner which serves not only mallet fabrication, but also the general workshop and main store area.

RESULTS: In addition to solving the specialized humidity problem, the system is providing summer comfort.

New Mail Cars From Old Diners

PROBLEM: Faced with a need for several new mail cars, the Great Northern Railroad undertook to remodel older dining cars which had been outmoded.

SOLUTION: Four such cars are being rebuilt in the railroad's St. Paul shops. Bright lighting, carefully engineered letter dispatching equipment, a steam heated coffee cooker, ice box, and a new automatic thermostatically controlled steam heating system designed by Vapor Heating Corp. are being installed. The inside of the car was first stripped down to the frame with all diner equipment, roof and flooring removed. Spun glass insulation was installed with new walls, windows, flooring and equipment all made in accordance with specifications of the Railroad Mail Service. The heating system is planned to provide enough heat to offset blasts of cold air coming in from open doors at station stops but will not overheat the car when the doors are closed. Steam from the locomotive is the main source of heat while a coal stove in the baggage section is provided for emergency use. Thermostatic controls are provided so that personnel can select the temperature desired. In addition to finned radiation along the sides of the car, an overhead heater fan draws air upward from the bottom of a unit heater and forces it out through four sections of steam heated fins. Heating pipes are also placed under the sliding doors to keep channels from freezing.



RESULTS: A comfortable modern mail car is made from an outmoded diner.

Plastic Pipe Used for Irrigation System

PROBLEM: At the Scottsbluff, Nebraska Country Club, it was decided to install an underground irrigation system. Corrosive contents of the soil were such that metal pipe would not be satisfactory in this application.

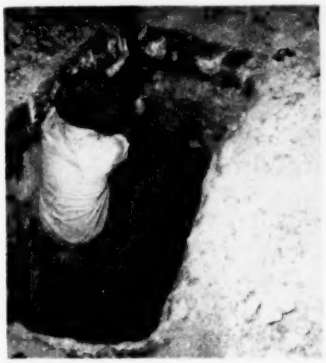
SOLUTION: Vinyl plastic pipe was selected. The pipe was extruded by The Prima Pipe Co., Scottsbluff, Nebraska, and was made from Geon polyvinyl chloride resin, a product of B. F. Goodrich Chemical Co.

RESULTS: The initial installation cost was reduced because plastic pipe can be buried underground without protective coating. Maintenance costs are also low, as the pipe resists the rusting or rotting effects of most chemicals and soil alkalies and the corroding effects of electrolysis. Since plastic pipe is lighter than steel, freight and shipping cost as well as handling costs were also reduced.

Pipe Pusher Installs Water Main Under Street

PROBLEM: A water service line sprang several leaks between a house and the city water main, located on the opposite side of the street. A new line was to be installed at minimum cost without trenching across the street.

SOLUTION: A Trojan Model A pipe puller and pusher, product of Trojan Manufacturing Co., was used. Only three holes were dug in the ground, a 5-foot trench near the city water line, another at the opposite curb, and a smaller trench at the spot where the old line left the house. Using a backing plate, the pusher was set up in the trench at the city water line. Using a 5-foot lever and 1-inch double extra heavy steel push pipe, the initial push was made on the water line to the opposite curb, a distance of 40 feet. One man made this push in 35 minutes including time required to put new lengths of pipe in the machine every 2½ feet. At the opposite side, new copper pipe was coupled to the push pipe and pulled back under the street by reversing the pipe puller. The pusher was then moved to the curb trench and another push of 15 feet was made to the house. The pull back of new pipe immediately following required less than twenty minutes.



RESULTS: Use of the pipe puller and pusher allowed completion of the job in less than 1/6 the time required for a complete trenching job. Savings to the customer were well over $100, and the street was crossed without blocking traffic or breaking pavement.

Cold Helps Make Peeled Potatoes

PROBLEM: At the Brennan Pre-Pared Potato Company in New Orleans, which is licensed to use a secret process and treating solution under patents controlled by Miller's Prepared Potato Company of Blue Island, Ill., potatoes are processed so that they can be shipped without spoiling after being peeled. The process involves treatment with a solution which must be chilled to a specific low temperature. Potatoes arrive at the warehouse in carload lots and are put through large automatic peeling machines where they are scrubbed with a hot caustic solution. Washed free of caustic, they are placed on a conveyor where eyes and other waste are removed. They are conveyed to a large slowly rotating drum containing the solution which must be carefully chilled at a very low temperature.

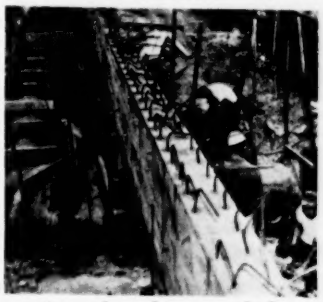
SOLUTION: To refrigerate the treating solution uniformly, a York High K cooler was installed. Continuous circulation of the treating solution over the cooler and then through the revolving drum assures proper cooling.

RESULTS: The stainless steel cooler surface assures maximum capacity. To restaurant owners the pre-pared potato has meant the end of the potato peeling machines and the labor of removing skins and eyes. The Brennen Company offers statistics showing that many restaurants have cut potato costs as much as 30% where peeled potatoes are used. A peeled potato does not spoil or change color for several days even without refrigeration, although refrigeration is an essential part of the preparation process.

Clay Pipe Serves Air Conditioning

PROBLEM: In combination service stations and restaurants now being constructed on the extensions of the Pennsylvania Turnpike, air conditioning was specified. Underground return air ducts were required to serve buildings, which are of early Pennsylvania Colonial design.

SOLUTION: Vitrified clay pipe was specified for the underground return air ducts. A total of 231 feet of clay pipe ranging from 8 to 30 inches in diameter was installed in each of the buildings. Clay fittings including reducer tees, ells, and increasers were also used. Construction of the building is under contracts handled by Gulf Oil Company.



RESULTS: Clay pipe is used to insure against corrosion of underground ducts.

Storeroom Condensation Stopped

PROBLEM: In many warehouses and store rooms where food, steel, furniture, or other damageable items are kept, atmospheric condensation has been a serious problem.

SOLUTION: An automatic control system engineered by The Foxboro Co., Foxboro, Mass., is described in data sheet 000-8. The system keeps the temperature of stored material above the dewpoint of the air. It takes corrective action before moisture conditions develop by measuring both the air temperature and the dewpoint of the air, as well as the temperature of the material in storage. When the temperature of the material approaches the dewpoint, the instrument positions valves in the heating system preventing moisture condensation. Key component of the system is the Dewcel element which, requiring neither refrigeration nor air circulation, continuously measures dewpoint temperatures over a wide range.

RESULTS: An instrument is provided which prevents spoilage by condensation on materials in storage.

Alaska Shop Air Conditioned

PROBLEM: The instrument repair shop at the Ladd Air Force Base in Fairbanks, Alaska required accurate weather control to offset June temperatures in the 90's during 22 hours of daily sunlight.

SOLUTION: A Trane air conditioning system was installed.

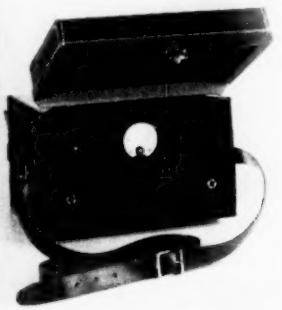
RESULTS: Aircraft instruments can be adjusted at constant temperatures to insure accurate, dependable performance. The shop is kept at a comfortable 70F and 55 to 60% RH.

NEWS OF EQUIPMENT AND MATERIALS

Use the prepaid postcard opposite page 145 for securing additional information on items described in this department.

Sound Analyzer Measures Noise

Type 420-A sound analyzer, which separates noise, sound and vibration signals into their component frequency bands for frequency analysis in measurement of noise intensity for fan and blower noise, industrial hygiene, and acoustical contracting applications, is distributed by Hermon Hosmer Scott, Inc., Cambridge, Mass. High and low-pass filters can be independently adjusted in steps of half octave. An interlock permits the pass-band width to be fixed in any multiple of the half octave. The position of this passband can then be adjusted throughout the audible range by a single control.



The analyzer is housed in a saddle-leather case and a shoulder strap allows the instrument to be used while the operator is walking about. It includes a calibrated attenuator, an indicating meter, and an output jack for general purpose filter applications. The unit may also be used as an amplifier having a range exceeding 20 to 20,000 cps. The analyzer weighs 20 lb and is 10 x 10 x 6 inches in size.

More information? Circle Item 1 on postcard, page 145

Screw Feed Coal Conveyors

An adaptation of coal stoker screw feeds for use as a larger scale automatic conveyor is announced by Canton Stoker Corp., Canton, O.

Called Flo-Tubes, the cast iron trough is bolted together in sections, capped with removable steel plates, and inserted in bottom of bin or pile with end exposed for pick-ups.

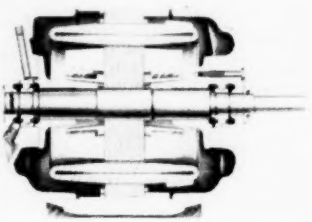
When used on an incline, it fills one hopper directly or two hoppers by a Y chute arrangement at the top end as illustrated. Horizontally, a single conveyor using two gate valves will feed from two to a battery of hoppers.

High and low level in hoppers are maintained by switches automatically starting and stopping the screw feed. Range of sizes up to 10,000 lb of coal per hour are available.

More information? Circle Item 2 on postcard, page 145

Motor Is Totally Enclosed

A new totally-enclosed motor, designated as Type SS, designed for services where dampness, dust, fire hazards and corrosive fumes are prevalent, is produced by U. S. Electrical Motors, Inc., Los Angeles, Calif. Because of its construction, it is self-cooling, eliminating the use of an exterior fan and heat-dissipating fins.



Its exterior lends itself to wiping off or hosing down, an important feature for motors to be used in dusty and dirty locations. It is also provided with a slinger to protect the output shaft bearing against the entrance of dirt or water. The motor is also available in Type SES.

There sometimes occurs in totally-enclosed motors a moist condensation caused by breathing of a motor under certain conditions, causing grounding of the motor. To overcome this problem, the firm has available a drain plug which will release water from the interior while still retaining explosion-proof characteristics.

These motors are immediately available in a range from 1/3 to 2 hp and as fan-cooled to 75 hp. They have these additional features: sealed terminal chamber; normalized castings; asbestos-protected windings; solid centricast rotor; Lubriflush bearings which provide an extra large lubricant chamber and provision for forcing the grease through the bearing for a thorough purge of the old grease.

More information? Circle Item 3 on postcard, page 145

Sump Pump Is Submersible

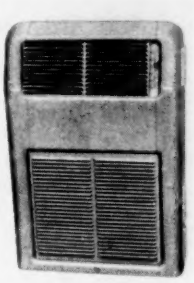
A new submersible type sump pump and basement drainer, employing a totally enclosed on-off switch sealed inside the water-tight stainless steel motor case, is placed on the market by Jacuzzi Bros., Inc., Richmond, Calif. Called the Sub-Drainer, there are no separate floats or projecting liquid-level controls.

The hermetically sealed 1/3 horsepower motor, complete with 11 foot water-proof cable, and the pump unit operate when submerged partially or under as much as 15 feet of water. These pumps may be used for emptying sumps, pumping seepage water from under buildings, removing water from ponds, swimming pools and many other farm, domestic or industrial pumping jobs. Standard, corrosion resistant model pump lists for $74.50.

More information? Circle Item 4 on postcard, page 145

Units Modulate While Heating

The new Swenco heating system for homes and commercial buildings, which is said to combine the advantages of thermo-statically controlled steam heat and forced warm air is announced by Swenson Thermal Research Inc., Cleveland, Ohio.



Designated as a modulating system, the system operates from an insulated steam boiler placed anywhere in the structure with the system utilizing small diameter copper tubing for steam and condensate return which is installed like house wiring from boiler to individual heater units in each room.

Each room heater unit draws in cool room air—filters it clean—heats it with steam to the individually selected thermostat controlled temperature—then blows it gently and quietly back into the room with its steam operated turbine blower. No electricity is used in the system. The thermostat is incorporated in the heating units which are available in three sizes.

According to the manufacturer, each heater unit operating in the system is in effect an automatic heat meter constantly and accurately measuring the heat required to compensate for variable heat losses in the zone it controls. Each will modulate in its operation from 1/20th of its capacity to full, producing only the heat required where and when it's wanted.

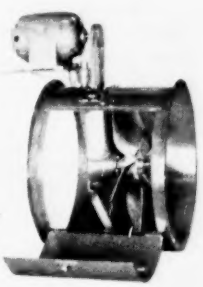
It is stated that the system offers the following advantages: individually selected temperatures for each room; constant circulation of filtered air; low operating cost; compact modern design adaptable to any architecture; low installation cost with tubing installed like house wiring; and silent dust-free modulating operation.

The new system is applicable for new construction, replacement systems, hotels, motels and multiple unit structures. The system carries a one year guarantee.

More information? Circle Item 5 on postcard, page 145

Duct-Mounted Door Exhaust Fan

A new duct-mounted door exhaust fan designed for simplicity and convenience in periodic inspections and maintenance is announced by M & E Mfg. Co., Indianapolis, Ind.



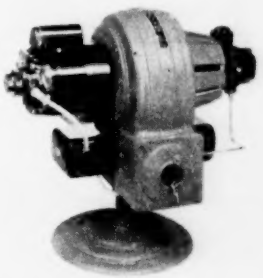
A range of sizes from 12 to 48 inches diameter for removal of 900 through 38,000 cfm is incorporated with the heavy cast aluminum blades, vapor tight belt drive enclosure, and sealed ball bearings.

High efficiency for any condition may be obtained with V-belt drive as any desired fan speed may be obtained, thus permitting the fan to be fitted exactly to the particular requirements.

More information? Circle Item 6 on postcard, page 145

Larger Capacity Oil Burner

The replacement of the Model 4G oil burner with the newly designed N4G which has larger capacity and greater operational efficiency, is announced by Radiant Utilities Corp., Brooklyn, N. Y.



Model N4G has a capacity of 15-30 gallons, an increase over the former model of 5 gallons. It contains a flange mounted ½ hp motor with overload switch and twin ignition consisting of two transformers. There is a pyrex glass in the backplate.

Like all other of the firm's models, it is a one piece machined housing.

More information? Circle Item 7 on postcard, page 145

Stick Form Seal for Oil Leaks

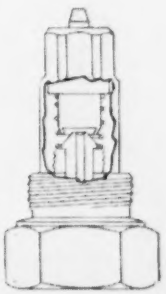
Oyltite, which stops leaks in oil pipes, tanks and containers or around leaky joints, is introduced by Lake Chemical Co., Chicago, Ill. It is in handy, easy to use stick form and can be applied while oil is running through pipes or is present in tanks. It withstands vibrations and changes in temperature.

It is reported to be an excellent product for use on those many service calls where leaky fuel oil storage tanks would ordinarily require more expensive and time consuming repairs. Being in stick form it easily reaches many hard-to-get-at areas.

More information? Circle Item 8 on postcard, page 145

Fuel-Unit Has New Valve

The introduction of a new type of valve assembly into current fuel-unit construction is announced by Webster Electric Co., Racine, Wis. This new valve, now available in both single and two-stage fuel-units, is said to be immune to deterioration beyond all normal operating conditions, and completely eliminates nozzle drip.



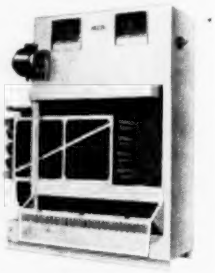
The valve assembly consists of a crown-shaped stainless steel valve seat and a valve containing a special plastic disc which swallows metal particles and other foreign matter which might prevent perfect seating with ordinary valve construction. The assembly is interchangeable in all of the company's electric fuel-units sold in the past 16 years.

Literature is available on the 6,000 Series Fuel-units, of which the new valve is a part.

More information? Circle Item 9 on postcard, page 145

Evaporative Condensers

A redesigned line of evaporative condensers featuring versatility is introduced by United States Air Conditioning Corp., Minneapolis, Minn. Called the evaporative condenser model ECU, the equipment is in six sizes with capacities ranging from 7½ to 40 tons.



A completely assembled unit, the evaporative condenser is ready for immediate operation. However, its design of building block construction and removable sectional components permits it to be disassembled in the field and reset in any of sixteen different arrangements to meet specific installation requirements.

All panels and sections, including coil, eliminator, blower, and air intake, are removable and reversible, so that rearrangement can be effected quickly and easily. All sections are bolted together with rubber gaskets between for water tightness.

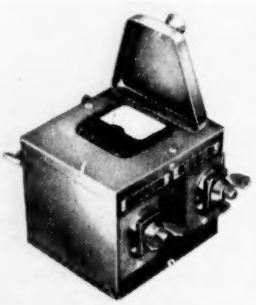
Steel parts of the condensers are hot-dipped galvanized after fabrication to assure corrosion-free operation. Heavy gage construction includes 12 gage tank, 12 gage end frames, and 16 gage panels.

Characteristics of the new equipment are: blower sections which can be reversed or rotated to exhaust vertically or horizontally to front or rear, and new blade design allowing low blower speeds; suitability for outside use; accessible bearings located on the outside of the cabinet; compact assemblies with maximum dimensions ranging from 102 inches high by 51 inches wide by 37 inches deep, approximately, for the 7½-ton unit, to 116 by 118 by 51 inches, approximately, for 40-ton equipment; conveniently designed air intake, covered by hinged access screen which can be readily shifted from one side of the assembly to the other if required; and spray assembly utilizing large orifice, low pressure and non-clogging nozzles.

More information? Circle Item 10 on postcard, page 145

Device Protects Welder Machine

A new protective device which will give an engine driven welding machine protection from overload damage when the machine is being used to thaw frozen water pipes, is manufactured by The Lincoln Electric Co., Cleveland, Ohio.



Welders used for continuous operation above rated capacity may overheat, causing either serious damage to the insulation or completely burn out. The new device, called the Linc-Thaw, hooks into the output circuit of the welder and indicates at all times what current is passing through the lines. A fuse limits current output to the rated maximum for the generator on continuous duty.

The unit can be attached directly to the frame of the machine or placed in any convenient location. The output leads of the machine are connected to one side and the leads to the frozen water service are attached to the other side. The welding machine is started and the output current adjusted according to the meter reading shown on the unit.

The device is designed in several ratings for operation with the firm's Shield-Arc engine driven welders of 200, 300 and 400 ampere capacity. It may be used, however, on any make or model of engine driven welder. It must only be used with the proper lag-type fuse and must be used only with the size machine for which it has been rated.

More information? Circle Item 11 on postcard, page 145

Valves Have Adjustable Timing

Further improvement on its line of solenoid valves has been announced by The Atkomatic Valve Co., Indianapolis, Ind. Adjustable timing on the closing stroke is now available on all valves of pressures up to 300 psi.

The new feature is said to eliminate shock on supply lines, particularly on hydraulic operations, oil, water, steam, air, gases, and any media not harmful to bronze.

Bulletins dealing with its industrial applications and showing typical operating diagrams are available. The folders list some of the types of valves offered and give charts for their dimensions.

More information? Circle Item 12 on postcard, page 145

Filters by Static Electricity

A new washable plastic air filter, designed to trap and hold the finest pollen, soot, and dust particles by static electricity has been developed by Goodyear Tire & Rubber Co., Akron, Ohio.

Named Pliotron, the filter utilizes the inherent conductive characteristic of polyethylene film. It is produced in 4 sizes: 16 x 20, 16 x 25, 20 x 20, and 20 x 25 inches. All models are 1 inch thick.

The filtering agent in the new product contains a lifelong electrostatic charge. When air is forced through the plastic material it takes on an additional charge. This electric charge attracts dust particles in the manner a magnet attracts metals.

These filters can be installed without modification of present forced-air systems. The filter is cleaned in a few minutes by gently rinsing in clear water and may be replaced without drying.

More information? Circle Item 13 on postcard, page 145

(*Continued on page* 124)

Architect—Benjamin A. Crowther. General Contractor—Decker Construction Corporation, both of Elmira, N. Y. Heating Contractor—A. J. Eckert Company Incorporated, Albany, N. Y. Revere Dist. —LeValley-McLeod, Schenectady, N. Y.

ANOTHER CASE OF *Copper* WHERE IT COUNTS

This ultra-modern Motor Inn located just outside of Albany, N. Y., on Route 20 has all of its 100 rooms, lobby and dining room heated by radiant panel heat. Almost 24,000 feet of Revere non-rusting Copper Water Tube was used. A section of the control system is shown in photo at top right. System was designed for zone control, a most desirable feature of radiant panel heating. Note compactness and neatness of installation when you use Revere Copper Water Tube.

Now with restrictions eased, and quantities permissible without allotments greatly increased, there isn't any reason why your next job can't have the many benefits of Revere Copper Water Tube for radiant panel heating, hot and cold water lines, underground service lines, processing lines, and waste stack and vent lines. See the Revere Distributor nearest you today. And, if you have technical problems, he will put you in touch with Revere's Technical Advisory Service.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.— Sales Offices in Principal Cities, Distributors Everywhere.

SEE REVERE'S "MEET THE PRESS" ON NBC TELEVISION EVERY SUNDAY

WHY REVERE COPPER WATER TUBE IS PREFERRED BY

Architects, Builders, Plumbing & Heating Contractors

EASY TO BEND

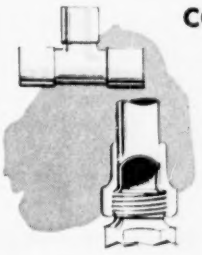
Saves Time

Revere Copper Water Tube is easy to bend. Soft temper can be bent by hand to meet installation conditions. Hard temper by hand bending tools.

HANDY LENGTHS

Save Fittings . . . Labor

Revere Copper Water Tube comes in straight lengths of 20' in hard and soft tempers. 60' coils of soft temper reduce the number of fittings needed.



SOLDER OR COMPRESSION FITTINGS

Need Less Work Room . . . Save Metal

No worry about wrench room when you use Revere Copper Water Tube with solder fittings. Compression fittings can also be used. No threading is necessary with either type fitting. Wall thickness of tube used can thus be less than for threaded pipe.

(*Continued from page* 122)

Automatic Electric Sump Pump

The Model 51 automatic electric sump pump made in one size at a nominal capacity rating of 3000 gph to operate against discharge heads up to 22 feet of water, is manufactured by Penberthy Injector Co., Detroit, Mich.

It has a ⅓ horsepower resistance split phase motor designed for vertical operation at 1725 rpm. A double pole mechanical switch is mounted within the housing cast integral with bell end of motor.

The pump is 3 feet 2 inches high with 8 inch diameter at base and is list priced at $70.

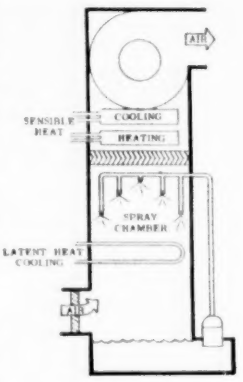
An automatic control switch is operated by a pair of small, non-breakable and chemically inert displacement weights that are adjustable on a stainless steel cable. When sump fills with water, weights are submerged and their loss of weight permits a spring within the switch housing to close the switch. When sump empties, the weights become heavy enough to overcome resistance of the spring and pull the switch open.

Overload protection is built into the motor and the pump is of top suction submerged type with brass strainer of ample capacity. A double shroud balanced bronze impeller operates in carefully proportioned pump housing. Holes are provided in the pump base to anchor it in sump if desired.

More information? Circle Item 14 on postcard, page 145

Conditioning Unit Is Improved

An improved apparatus for the drying or moistening of atmospheric air by its liquid contact method has been developed by Niagara Blower Co., New York, N. Y. Air is treated to fix relative humidity and temperature independently, as separate functions, to obtain close control of results.



Filtered fresh air enters a new type of spray chamber providing intimate contact between air and the spray liquid. The spray either adds moisture or removes it by absorption or by condensation. The temperature or absorbent concentration of the spray liquid determines the moisture content of the air leaving the chamber. The final temperature is fixed as a separate function, either within the apparatus or external to it, thus giving trustworthy control of room conditions by means of thermostats, without the use of moisture sensitive instruments.

The spray liquid used for removing moisture may be either refrigerated water or the company's Hygrol, a stable organic absorbent liquid which is automatically held at the proper concentration. When Hygrol is used the latent heat of condensation of the moisture removed may often be absorbed by evaporatively cooled water. The dew point of the air is fixed and final conditions are held automatically constant or varied by either adding or removng moisture in response to changing the instrument setting.

Applications include the establishment of dry atmospheres for protection, processing or drying of moisture sensitive materials, testing materials, and conditioning of air for human welfare.

More information? Circle Item 15 on postcard, page 145

Water System for Deep Wells

A 2-stage water system for installations requiring higher discharge pressures and deeper wells the MHN Ejecto is introduced by The F. E. Myers and Brother Co., Ashland, Ohio.

Available in ½, ¾ and 1 hp sizes, the system will deliver water from depths as low as 160 feet and will build up discharge pressures as high as 60 psi. This is done by means of two all-bronze impellers in the pump casing.

Coming complete with pump and tank assembly, features of the new system include simple mechanical construction and a standardized motor loading.

The ejector bodies, foot valve, impellers and wearing rings are all brass. The pump shaft is stainless steel and uses the same rotary seal as all others of the company's line.

More information? Circle Item 16 on postcard, page 145

Hand Torch Has 6 Burner Tips

The new Prepo gas torch with six interchangeable burners and tips, which comes in a metal carrying case containing space for extra fuel tanks, is announced by Bell & Gossett Co., Morton Grove, Ill.

The six interchangeable burners and tips make it possible to tailormake the torch with a heat tool designed to perform a specific job. They include: a utility burner for general purpose work; heavy duty burner for greatest heat volume; pin point burner for precision work; paint remover tip; diamond point solder tip; and chisel point solder tip.

Weighing little over a pound, the torch has instant lighting and gives full heat promptly. Its compact size enables the tradesman to work in small, congested areas. The unit is 4 inches wide and 10½ inches high.

Disposable fuel tanks containing a hydro-carbon blend, eliminates the handling of flammable liquid fuel. A fuel container will last from 1½ to 4 hours depending on the burner or tip used.

More information? Circle Item 17 on postcard, page 145

(*Continued on page* 126)

WeldELLS®

...have set their own standards

Many of the largest users of Welding fittings refuse to accept any other fittings than WeldELLS.

They have found that when the name, WeldELL, is stamped into a fitting, that fitting can be accepted without question for any service for which it is designed.

They have found that WeldELLS have features that please both the men who design and the men who erect welded piping . . . features that were pioneered by Taylor Forge . . . features that are combined in no other welding fittings.

They have found the answer to their every need in the greater range of sizes, weights and types of the WeldELL line . . . in the broader scope of materials.

For up-to-the-minute facts
See your Taylor Forge Distributor

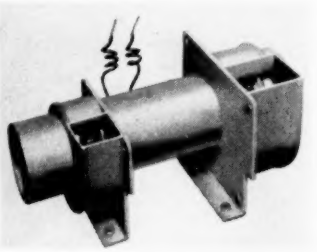
TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS, General Offices and Works: P.O. Box 485, Chicago 90, Ill.
Offices in all principal cities. Plants at: Carnegie, Pa.; Fontana, Calif.; Hamilton, Ont., Canada

(*Continued from page*

Small Blowers in 2 Models

Two fractional horsepower motor blowers are now available from EMC and CYCLOHM Divisions of Howard Industries, Inc., Racine, Wis. Currently being used for cooling aircraft electronic equipment and micro-wave relay equipment, the motor blowers are manufactured in a range of motor types and horsepower ratings as well as blower heads.



Model 100 DC motor (illustrated) is rated 1/50 hp at 27½ volts. Designed for aircraft, this model operates a 4,500 rpm at sea level, 6,500 rpm at 50,000 feet with a relatively constant air delivery of 40 cfm. Ambient temperature range is −65 C to 70 C.

Model 2914 is a induction motor rated from 1/100 to 1/15 hp. Currently used for micro-wave relay equipment this motor operates at 1,650 rpm with an input voltage of 90-120 volts. Motor is self-ventilated and is available with ball or sleeve bearings. Air delivery of double blower is 37 cfm each head at 95 volts AC.

More information? Circle Item 18 on postcard, page 145

Sewer Joint for Waste Lines

A ductile, chemical resistant sewer joint for joining vitrified clay pipe waste lines in the chemical process industry, is available from The Atlas Mineral Products Co., Mertztown, Pa.

The new joint is precast on the job using a new hot-poured plastic composition called JC-60. The molds used on the bell and spigot section are designed so that considerable space remains at the base of the spigot and between these two precast components. When the line is laid, these spaces are filled with a new chemical resistant cold-setting cement called Vitroplast. The resulting plastic joint is both ductile and resistant to all common solvents, acids and other corrosives expected to be found in chemical wastes.

More information? Circle Item 19 on postcard, page 145

Beam Compass Uses Steel Rule

An Omicron steel beam compass with a 72 inch radius capacity is marketed by A. Partrick Co., Westwood, N. J. It is designed for use in shop layouts as well as on the drawing board.

A steel beam on edge is for assurance of parallel disposition between center pin and scriber. To move the beam, an automatic locking lever is depressed, and by pumping locking lever, minute adjustments are made.

The unit contains no separate parts to put together, and it measures from a few inches to 144 inches in diameter. It can be operated with one hand. The compass is also a rule with a scriber on each end. Priced at $7.50, a scriber for metal work is included with the unit.

More information? Circle Item 20 on postcard, page 145

Duct Sealing With Tape

A method of joining air ducts and sealing joints, applicable to both home and industrial heating and air conditioning installations, including a single wrap of tape around each joint, is announced by Minnesota Mining and Mfg. Co., St. Paul, Minn.

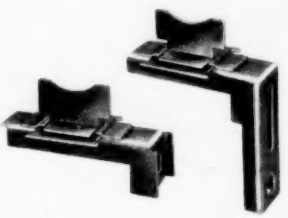
The tape, Scotch brand plastic film tape No. 472, holds the joint with great mechanical strength and provides a very efficient seal against air loss. Other advantages include long life and resistance to humidity changes, moisture-vapor, and rodents.

Designed for use on round, square, or flexible metal ducts, the highly abrasive-resistant tape features 125% stretch with minimum creep, a 9-mil thickness, and a 240F softening temperature. Its vinyl plastic film backing will withstand acids, alkalies, salt solutions, water, alcohols, ethers, and hydrocarbons such as gasoline and kerosene. It is available from paper jobbers in various widths on 36 yard rolls.

More information? Circle Item 21 on postcard, page 145

Adjustable Fin-Tube Hangers

Adjustable hangers for fin-tube radiation with a sliding cradle which permits expansion and contraction of heating elements are available from Radiant-Ray Radiation, Inc., New Britain, Conn.



Although designed primarily for use with the firm's own Airfoil finned radiation, the new hangers are suited for all makes of fin-tube radiation having 1¼ and 2 inch tube sizes. The sliding cradle fits either pipe size and provides a maximum travel of ¾ inches to accommodate the expansion and contraction of heating elements. This is said to eliminate rappings and noises caused by pipe movement and prevents the expanding elements from tearing out anchor bolts.

The new hangers are offered in two styles. One model is designed for direct-to wall mounting and is adaptable to all types of fin-tube and enclosure The second style is intended for use with the firm's enclosures.

More information? Circle Item 22 on postcard, page 145

(*Continued on page* 128)

Famous Labels suggest the choice

Many of the big textile mills . . . names your wife will recognize . . . "air-control" many of their manufacturing operations with Worthington air conditioning and refrigeration.

And many of the famous shops where the mills' products are sold . . . Saks Fifth Avenue, The Higbee Company, J. L. Brandeis, Lane Bryant, many Sears Roebuck Stores . . . are air-conditioned by Worthington.

No other manufacturer makes so complete a line. A Worthington system is all Worthington-*made*—not just Worthington-assembled—assuring you of perfectly balanced operation and unit responsibility.

Call your local Worthington distributor today. Worthington Corp., Air Conditioning and Refrigeration Div., Harrison, N. J.

America's Leaders... in Many Businesses... Select

WORTHINGTON

A.2.9

AIR CONDITIONING AND REFRIGERATION

The Most Complete Line... Always the Correct Recommendation

(*Continued from page 126*)

Gas Fired Unit Heaters

An expanded line of its Series 23 gas fired unit heaters in capacities ranging from 55,000 to 400,000 Btu per hour introduced by the United States Air Conditioning Corp., Minneapolis, Minn. These heaters are designed for the elimination of hot and cold spots on the heat exchangers.

In both cast iron and sheet steel types, the new design is said to feature an even temperature removing the hazard of burn outs and rust outs due to overheating and underheating.

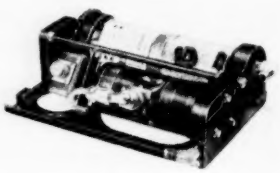
There is no combustion chamber in the units. Heat generated by the burning of the gas occurs only in the heat exchangers from which it goes directly to the circulating air.

Bulletin 23-2, describing the new line giving capacity tables and roughing-in dimensions is available. It also includes a line of blowers which can be used with duct work.

More information? Circle Item 23 on postcard, page 145

Desiccator Pumps, Dehumidifies

Type B-1A desiccator for pumping and de-humidifying air in closed system to prevent frosting or fogging of dome lense of the vertical periscopic bombsight of aircraft is manufactured by Romec Div., Lear, Inc., Elyria, Ohio. Air is sucked through the pump, forced through the desiccant jar, and repeatedly returned to the bombsight lense dome in a renewed dry state. Desiccant jar contains a breather which replenishes with dry air any loss in the otherwise closed circulating system.



The replaceable jar of anhydrous $CaSO_4$ Drierite is inserted when contents of used jar is saturated. Color indicates approximate relative humidity as adsorption progresses. Content of replacement jar is light blue, which gradually turns pink in the presence of moisture laden air adsorbed on the granules. Danger line is indicated on jar.

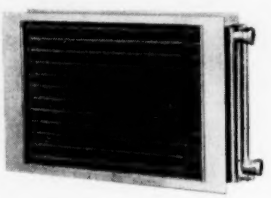
Pump is oil-free, so no oil vapor is contained in the discharge. Rotor, liner, and sliding blade are self lubricating, built integrally with, and driven through direct drive of the motor.

Motor is 1/50 hp, 27 volts, DC, 1.5 amperes, continuous duty, enclosed explosion proof type. It has useful brush life and motor life of 500 hours at 40,000 feet. Electrical circuit contains radio interference filter with AN 3102 receptacle connector to power source. Desiccators are also available with 115 volts AC, 400 cps motor. Unit is corrosion and fungus resistant.

More information? Circle Item 24 on postcard, page 145

Steam Heating Coils

A new line of steam heating coils, in capacities ranging from 60,000 to 775,000 Btu per hr, for use in combination with air conditioning coils or as tempering and booster units in long heating ducts, is announced by Rempe Co., Chicago, Ill. The coils are available in both single and double row design. The single row is suited for booster and tempering service and the double row for heavy duty or mixed air heating service.



Units are constructed with heavy gage steel casings, copper tubes and headers, 7 aluminum fins per inch. All fins are collared to tubes. Coils are tested 350 Psi air pressure for steam working pressures up to 125 psi.

More information? Circle Item 25 on postcard, page 145

Adds Humidifier, Conditioner

Added to its line of 1953 appliances by Hotpoint Co., Chicago, Ill., are a new portable dehumidifier and a room air conditioner.

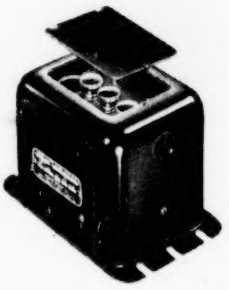
Air conditioners are produced in one model, a 3/4 hp unit that will cool a 500 square foot area, and will exhaust room air at a rate of 200 cfm. The conditioner automatically mixes and circulates any desired combination of fresh and cooled room air. It can be used for cooling and dehumidifying in summer months, and for exhausting stale air in the winter.

The portable dehumidifier will extract more than three gallons of water per day from up to 10,000 cubic feet of room air. A 22-pint capacity water pan that collects condensed moisture, pollen and dust can be emptied periodically by the user, or connected to a floor drain.

More information? Circle Item 26 on postcard, page 145

2 New Oil Burner Transformers

Two new additions to its oil burner ignition transformer line, the Type U and the Type CU, are announced by Webster Electric Co., Racine, Wis. The company states that these transformers save the serviceman's time because of their adaptability and accessability, and reduce inventories since they meet most replacement requirements.

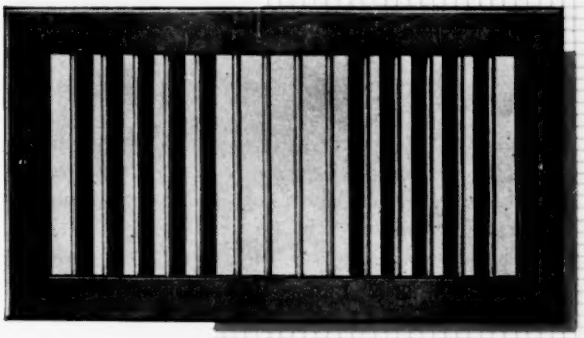


Among the features of these transformers are large, full junction boxes located either directly on top (Type U, illustrated) or at one top corner (Type CU) for accessability, and six knockouts instead of the usual four. Since these transformers use all of the company's standard bases, they can be used to replace most any of its transformers now in use.

More information? Circle Item 27 on postcard, page 145

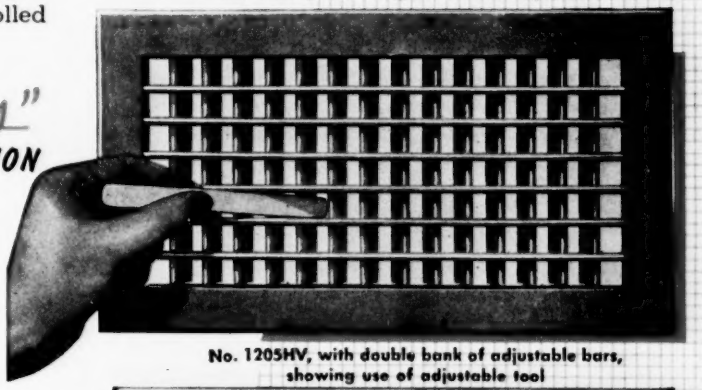
Auer "Streamliners"

. . . answer all Register and Grille requirements for high-velocity air conditioning systems



No. 1005V, with single bank of adjustable bars

• Efficient diffusion and absolutely quiet operation at high velocities are essential requirements of the outlets in the ideal air conditioning installation. Auer "Streamliner" registers and grilles give you both. The "Streamliner" series provides a full range of sizes, in models with single bank of adjustable bars (vertical or horizontal) double banks of adjustable bars (vertical in front and horizontal in back, or reverse), also all four types with multi-louvre valves at back controlled by a lever on the face.



No. 1205HV, with double bank of adjustable bars, showing use of adjustable tool

Auer "Streamliners"

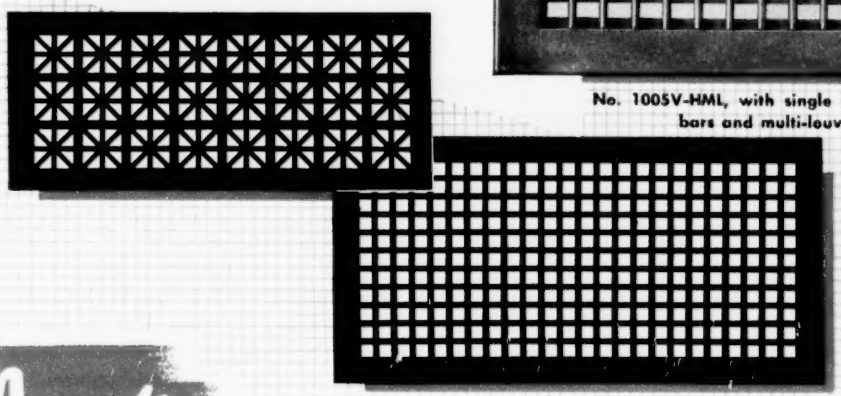
QUALITY CONTROLLED PRODUCTION

When you install Auer "Streamliners", you have the assurance of accurate dimensions and uniform high quality—the result of Auer's system of strict quality control of production. Smartly styled for attractive appearance, and expertly designed according to correct aerodynamic engineering principles, they provide every feature demanded by discriminating buyers.

Auer also makes a complete line of registers and grilles for residential installations.

For information on the complete Auer line, ask for the Auer "Register Book." For information on our quality line of perforated grilles, ask for Catalog "G".

No. 1005V-HML, with single band of adjustable bars and multi-louvre valves



Auer Perforated Grilles are available in wide variety of pattern styles made to order of materials and in sizes to meet individual specifications.

Auer REGISTERS and GRILLES

THE AUER REGISTER CO. 6600 CLEMENT AVE. • CLEVELAND 5, OHIO

Canadian Distributor—Marchand Furnace Ltd., Tilbury, Ont.

Abstracts AND Reviews

Publications abstracted in this department should be ordered direct from publisher.

STEAM POWER STATIONS

Dr. Gustaf A. Gaffert, mechanical engineer and partner of Sargent & Lundy, has had not only experience in teaching junior and senior courses in heat power engineering, but also extensive experience in the mechanical design of steam power stations. With this background to draw on he wrote Steam Power Stations which was published in 1937. The fourth edition of this book has just been made available.

Primarily this book is intended to familiarize mechanical engineering students with major and auxiliary equipment found in power stations. The author also reviews performances, costs, trends toward unit plant construction and some of the newer heat cycles.

While the presentation of material in this book is largely from a design and construction point of view, an objective has been to permit the practical man as well as the engineering student to expand his knowledge progressively—from the simple units to the point where the complete integration of all machinery is considered.

Included in this edition are latest data on cyclone firing, pressurized furnaces, axial flow fans and extraction cycle technique. At the end of each chapter is a list of reference material for those who would like to investigate some special field in greater detail.

Steam Power Stations, G. A. Gaffert. Cloth bound, 6 x 9 inches, 637 pages. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. Price, $8.

• • •

HANDBOOK ON AIR CLEANING—Purpose of this book is to make available to the Atomic Energy Commission personnel current data on air cleaning methods and criteria for judging their effectiveness. The discussion has been limited to particulate removal and no attempt was made by the authors to cover the allied fields of ventilation or the removal of gaseous contaminants. This book was prepared by Sheldon K. Friedlander, Leslie Silverman, Philip Drinker, and Melvin W. First. There are chapters on behavior of aerosols in air cleaning, air cleaning equipment, performance and evaluation of air cleaning equipment, and special problems involved in the cleaning of radioactive aerosols. Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price, 45 cents.

ACOUSTICAL MATERIALS—Special Technical Publication No. 123 of the American Society for Testing Materials covers a Symposium on Acoustical Materials as presented at the annual meeting of the society last year. The various papers that are part of this symposium discuss problems of sound absorption, maintenance, applications and relationships of many physical properties. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Price, $1.

ACCIDENTS IN PLUMBING OPERATIONS—Although the accident frequency rate for plumbers is considerably higher than the rates for most manufacturing activities, it is less than most of the workers in construction trades. This is the result of a study made for the years 1948 and 1949, and published as Bulletin No. 1079 on Injuries and Accident Causes in Plumbing Operations. The most common accidents are sprains, cuts, bruises, fractures, burns, foreign bodies in the eye, and hernias. This report not only analyzes the accidents, but has a list of suggestions for avoiding such accidents. The suggestions were prepared by the Division of Safety Standards of the Bureau of Labor Standards. Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price, 25 cents.

WELDABILITY OF METALS—Available as a 141-page volume is this information on how to weld ferrous and nonferrous metals. Included are the causes and cures for hard to weld metals and details of welding procedures for steels, nickel, iron, alloys, copper, aluminum, and hardfacing. It is a reprint of Chapter 2 from the standard welding reference, the Procedure Handbook of Arc Welding Design and Practice. Also included are the American Welding Society specifications for electrodes used to weld. The Lincoln Electric Co., Cleveland 17, Ohio. Price, 50 cents.

AIR INFILTRATION IN FAN TESTING EQUIPMENT—Results of a study by W. D. Scoates, Assistant Research Engineer, Texas Engineering Experiment Station, are given in Research Report No. 40, Determination of Air Infiltration in Fan Testing Equipment. For many years air infiltration into plenum chambers of standard test code equipment has been recognized. Recent research has found a method to measure this air infiltration quantitatively. The experimental setup and procedure followed in determining this type of air infiltration are described in the report. Texas Engineering Experiment Station, College Station, Texas.

NATURAL GAS PRODUCTION AND TRANSMISSION—Educational facilities of the Institute is being brought to a wide range of persons through a home study course which is being prepared in cooperation with the American Gas Association. The first of these courses is on natural gas production and transmission. Chapters 5 and 6 cover geological fundamentals and natural gas production methods. In all, there will be eight sections or booklets of two chapters each with a ninth section containing Chapter 17 and an index. The sections are punched for insertion in a looseleaf binder. Under the basic plan, each student is

(*Continued on page* 146)

Circulating conditioned air evenly throughout the smokehouse is a problem.

HOW TO "SMOKE OUT"

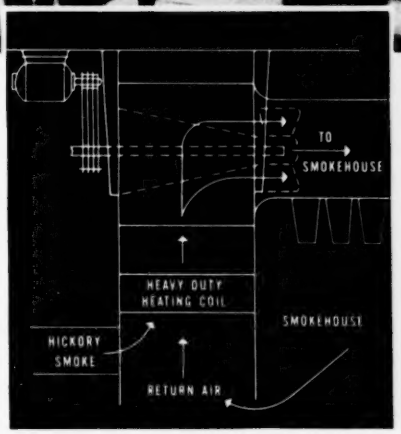
HIGH OPERATING COSTS IN A SMOKEHOUSE

The circulation of conditioned air, so necessary for smoking meats, has always been a problem. Tars accumulating on the fans and heating coils cut capacity, thus slowing down production. The necessary maintenance further increases operating costs, but not any more.

Armour and Company knew they needed a fan that would keep belts and bearings outside of the air stream. The housing had to be so shaped that it would not collect tars. The steam heating coil had to be sturdy, easily cleanable, and efficient.

Engineers of Armour and Westinghouse teamed up—decided on Westinghouse Elbow Axiflo® Fans and Heavy Duty Steam Coils built entirely of steel. This was the answer to this involved problem. The fans and coils fill the bill so well that they have now been put into service at 16 Armour smokehouses.

Some day you may have a problem that involves *putting air to work*. When you do, remember that Westinghouse has the most complete line of air handling, air cleaning and air conditioning in the industry. Ask for new Catalog 600. It contains 60 fact-filled pages on these products, and how they can put air to work for you. For your free copy, call your local Westinghouse-Sturtevant office. Or, write to Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Mass.



HOW A SMOKEHOUSE IS "SMOKED"

Hardwood smoke is drawn into the system and mixed with return air from the smokehouse. This mixture next passes over a heating coil to bring it to the proper temperature. An Elbow Axiflo Fan then turns it 90° into ducts which feed the discharge nozzles.

Note how fan motor, bearings and belts lie outside the air stream. This keeps them free of hazardous tar and heat, and makes them easy to maintain. The fan and coils are accessible, and all-steel construction withstands alkali cleaners.

YOU CAN BE SURE...IF IT'S

Westinghouse

AIR HANDLING

J-80284

Experience is my Classroom

By T. W. REYNOLDS

• SEATING CAPACITY CUT ADDS CUSTOMERS

As a general rule you cannot argue the average salesman out of the sale of an air conditioning unit solely on the basis that there is not sufficient space for it. Generally, the salesman will find some space, even if it is the transom, skylight, or the back of an outdoor advertising sign. However, in one case a salesman did find the space in a restaurant so restricted that the only recourse would be to remove a few seats. The owner, however, could not see much sense in reducing his seating capacity when the original idea of providing air conditioning unit was to fill the place to capacity. Neither could the salesman so he lost that sale.

Now along comes Salesman No. 2 and makes the sale by clear thinking and the presentation of some truths. He pointed out that while it was true the proposed unit would reduce the seating capacity by 5, it would nevertheless by its comfort inducement increase the customers by 10 or more; and that it was customers who were wanted, not seats.

Most certainly it was better to have 50 seats always filled and turn some customers away than to have 55 seats filled say half the time and turn no customers away. Furthermore, and what seemed most tangible to the owner, was the salesman's statement that the restaurant when air conditioned would reduce the required defrosting of the owner's coolers to a substantial extent and in this way reduce the cost of refrigeration.

• HOW TO USE LESS HEATING EQUIPMENT

High cost of labor and material and also mass housing have introduced a tendency to reduce this or that in size, or to omit some things. For example, the saving by cheapening of the trim on boilers is substantial if spread over 1,000 boilers for as many homes. All this may be quite necessary to the times and may get the proposed industry or residence down to pocketbook size. It may even provide an overall betterment.

For example, crawl spaces, used as warm air plenums, and open beam ceilings generally do away with the ducts, or a boiler or heater may be more economically used in the kitchen by justifying its location with a table top cover to serve as a piece of furniture. Some other bit of mechanical equipment may likewise be camouflaged or shrunk to a cabinet enclosure or else installed in some out of the way place where servicing may or may not be practical.

Crawl spaces are usually 18 inches deep and have insulated foundation walls to enclose a warm air plenum at a safe comfortable temperature of 85F. A wood floor furnishes about 40% of the required house heating by radiation, the balance being by convection from simple floor or baseboard registers. Perhaps the builder saves 300 lb of sheet metal or $200 in cost per house and he avoids the use of a subcontractor.

Houses of row construction are becoming favorites with some builders, because, among many other advantages, they do reduce heat losses by eliminating side walls with their windows and air infiltration. They, therefore, definitely reduce the size and amount of heating equipment. Piping can also be simplified if confined only to front and rear radiators.

With row construction, the heating contractor loses on job size but the builder gains by cost reduction. Thus, there is an elimination of all side walls with their windows except for the two end structures in the row, and a reduction in the extent of foundation walls, roof and land. As for the owner of the interior houses, he will have less painting and other maintenance and in general less upkeep for building and for heating equipment. He will also pay smaller fuel bills. The things this owner saves become the loss of the one who occupies an end house.

• HOT WATER REQUIREMENTS

From records and research, the Bell & Gossett Co. has determined the yearly consumption of hot water to be from 25,000 to 40,000 gal. for the average family, or 8,000 to 13,000 gal. per the average adult. These figures fluctuate within the given points, because the family may or may not stay overlong in the shower or in a deep tub.

Hot water per use is 10 gal. for the bath tub for an adult, 3 gal. for a baby, 8 gal. for an overhead shower, and 4 gal. for the laundry. To these figures must be added the 5 gal. of hot water used for miscellaneous cleaning per day 2 gal. for personal toilet per person per day, and ½ gal. for dishwashing per person per meal. The daily use of cold water will be about the same as for the total hot water used in the same period of time.

• SOUND INSULATION INCREASES NOISE

Sometimes I have wondered how my grandfather got along without a heating system, just as my grandchildren may eventually wonder how I was able to take it without any air conditioning in my home. This past summer makes me wonder myself.

At first a heating system was satisfactory, no matter how hot, dry, or dusty it was, while an air conditioning system was considered Utopia if just cool, or no more

(*Continued on page* 134)

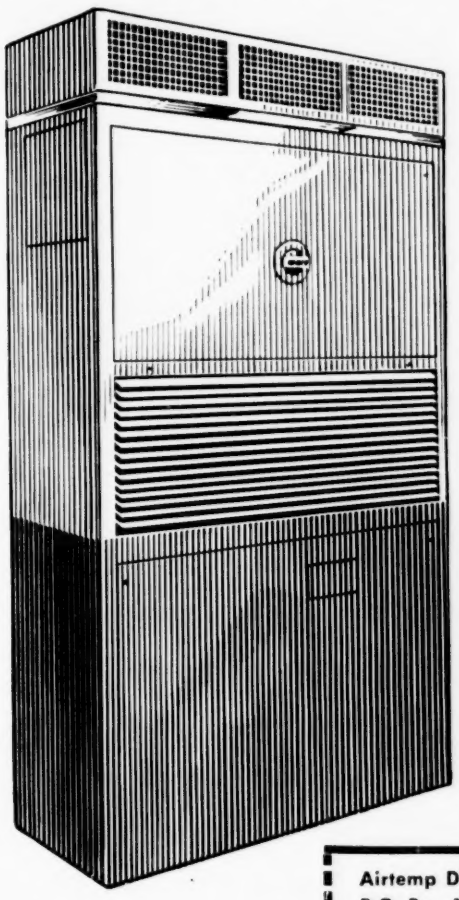
WHY CHRYSLER AIRTEMP IS THE FASTEST SELLING LINE OF "PACKAGED" AIR CONDITIONERS

There are lots of reasons why Chrysler Airtemp sells more "Packaged" Air Conditioners. One very important reason is *flexibility*. These unique advantages make Chrysler Airtemp a *more flexible* unit.

- You can distribute air from the front—or back—or both front and back—with a Chrysler Airtemp unit.
- You can have the return air enter the front—or the back—or both front and back—with a Chrysler Airtemp unit.
- You can put the evaporator and fan section in one place, and the compressor section in another.
- All compressors carry an optional 5-year warranty.

Chrysler Airtemp Field Engineers studied thousands of jobs and found this flexibility means *greater profit* for Chrysler Airtemp dealers!

Comfort Zone



"Packaged" Air Conditioners
Six models from 2 to 15 H.P. cap. Meets every cooling need.

Chrysler Airtemp

HEATING • AIR CONDITIONING
for HOMES, BUSINESS, INDUSTRY

Airtemp Division of Chrysler Corporation, Dayton 1, Ohio

Get all the facts . . . mail the coupon today

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P.O. Box 1037, Dayton 1, Ohio

Please send full details on Chrysler Airtemp Comfort Zone "Packaged" Air Conditioners.

Name _____

Address _____ Phone _____

City _____ Zone _____ State _____

(*Continued from page* 132)

than an ice house. Of course, if one is sinking one cares not whether the rescuing row boat is painted or otherwise.

To-day, a heating system must be noiseless in operation, adequately controlled, and the air preferably filtered and humidified. For an air conditioning system, all of these things are a must. For example, when a friend writes me that he is in trouble with noise in an office air conditioning system he installed for an owner I know he is really in trouble. Noise in air conditioning systems brings the most complaints to-day and the sources are usually varied and difficult to locate.

What puzzles my friend is why the installation was so quiet when first installed. This, however, is easily understood when you learn that the office space was acoustically lined and quieted only recently and upon further inquiry that the air conditioning noises were then developed or rather made noticeable. So I made the cause clearer to him by suggesting that either the number of persons and typewriters in the office be increased sufficiently to supply enough noise to equal that now absorbed by the office lining, or else that the new acoustical lining of the office be removed. Funny how more sound insulation made more noise.

• A CORRECTION ON ANTI-FREEZE SOLUTIONS

In my column in last month's issue in discussing the use of anti-freeze mixtures in hot water heating systems, I used the phrase "ethylene or propane glycol." This should have been, of course, ethylene or propylene glycol. Prestone (National Carbon Co.) should also have been mentioned as a widely used anti-freeze for the protection of heating systems.

• USE SMALLER DUCTS

A given air quantity in ducts must move faster to-day to the end that the ducts and furred ceilings will cost less. This added velocity tends to produce more noise at a time when we have become noise sensitive, although more learned in the ways of locating and absorbing or otherwise eliminating turbulence and noise. On a multi-story structure an extra floor may be gained by utilizing the total space squeezed out of ducts or their furred ceilings.

There is an alternative method for reducing duct sizes. It substitutes the possibility of air too cold for the chance of noise by the first mentioned method. Neither possibility need occur with proper design and equipment. One can even combine the two methods to make the ducts smaller than obtainable by either method alone. Who knows but that in this way two extra floors might be obtained. Of course there are limits to size reduction, especially so as space in buildings must be sufficient to at least work down a 4-inch rain water leader.

The alternative method requires the use of aspirating air diffusers to give adequate total circulation of air in the room when supply air quantities are substantially reduced through introduction of this air to the occupied spaces at temperature differentials as great as 26F below that of the space. The usual temperature differential has been for years not more than 15 to 18F in offices with less than 10 ft ceilings, but a differential of 26F has proven satisfactory even with low ceilings.

For an ideal effective summer temperature in a conditioned space of 71F, the dry bulb should be 77F and the wet bulb 62F. The supply air must then be at near saturation at about 51F to obtain the desired effective temperature.

Smaller ducts have advantages other than space saving. They provide less surface and fewer lineal feet of joints and therefore less dust and heat gain or heat loss for the supply, exhaust or return air ducts. Obviously, there will also be a reduction in the amount of heat and sound insulation, and in connected equipment, together with reduced weight all around.

• CORROSION PREVENTION

Since the minimum water temperature to make clothes sanitary in the washer is 145F, the water must be heated to at least 158F to take care of the average temperature drop in piping from heater to washer. This initial temperature of 158F is exactly 3F in excess of the critical temperature for corrosion, precipitation, sedimentation, and lining of a hot water heating coil. Therefore, there is greater need for corrosion prevention.

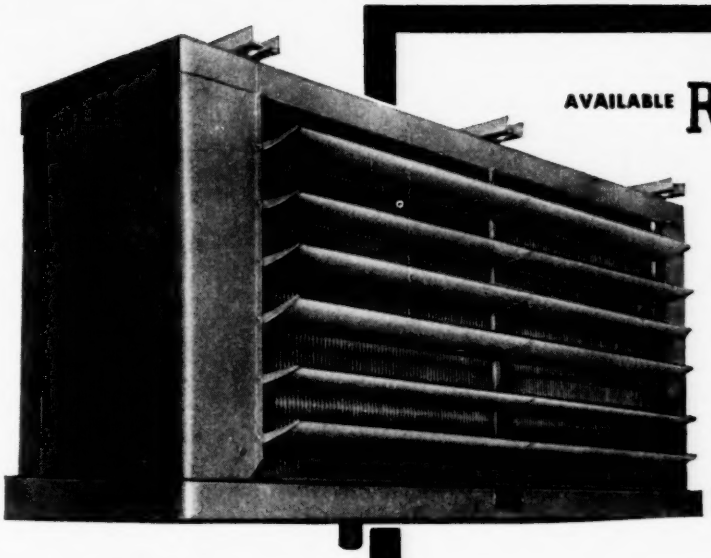
One automatic washer model now contains a rod immersion heater unit which will raise the water temperature in the washer to 145F if it is 10 to 15F below that upon entering the washer. No need then, in this case, for critical water temperatures in the piping system. Nevertheless some corrosion prevention may still be desirable.

• VENTILATING THE REMOTE TOILET

If it is a bank or some other building of great area and height the architect invariably seems to select some remote area of the basement for a single toilet. Although it is only one toilet fixture and out of the way, he little knows what he does to the mechanical designer. In the past, if not in many cases in the present, the local code always required that the toilet be mechanically ventilated, even though this meant a duct run of such length horizontally and vertically that no ventilation resulted. The code further required that the toilet ventilation system be separate from the general building exhaust ventilating system.

None of us could see the necessity of running a small duct all around a large basement and then up to the roof of a skyscraper, so we used to get around the requirements, at least in a practical sense, simply by routing the duct from the toilet to a point where it would form the nearest connection to the exhaust fan. By his method there could only be a remote liability of some slight odor some times backtracking into the general ventilating system when the fan was inoperative at night. In any event, at such times it seems that one could well reason there would be no one around either to use the toilet or to sense toilet odor if there was one. Nevertheless, the requirements had to be met if only in some apologetic manner as related.

To-day the small activated carbon odor remover is obtainable and where allowed its use will simplify the problem as cited and do a better job, the toilet air simply being used over and over again. The odor remover can also be used for the lone lavatory. One or more lockers or closets may be similarly treated.



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NEWS OF THE MONTH

ASRE CONVENTION

lectured on car air conditioning. Dr. Richard C. Jordan, University of Minnesota, is elected president.

Nine technical sessions covering various phases of air conditioning and refrigeration were held as part of the forty-eighth annual meeting of the American Society of Refrigerating Engineers at the Hotel Commodore, New York, N. Y., December 1 to 3. More than 850 members and guests attended.

The welcome luncheon at which Philip W. Swain, chief editor, Power, spoke on Plain Talk About Atomic Energy, was the first general event and this, plus all the technical sessions, were well attended. Exceptional interest was indicated in the subject of automobile air conditioning.

• **PROGRAM.**—The following papers were presented during the symposium on defrosting:

Review of Different Methods of Defrosting, Wilton W. Garland, chief refrigeration engineer, Frick Company, Waynesboro, Pa.

Hot Gas Defrosting, S. Charles Segal, sales manager, Kramer-Trenton Company, Trenton, N. J.

Air Defrosting, George A. M. Anderson, president, The King Company, Owatonna, Minn.

Water Defrosting, Daniel D. Wile, chief engineer, Refrigeration Engineering, Inc., Los Angeles, Calif.

Dehumidifying Systems, E. A. Windham, District Manager, Surface Combustion Company, New York, N. Y.

Controls for Defrosting, R. H. Luscombe, general sales manager, Penn Controls, Inc., Goshen, Ind.

The following four talks were part of a conference on product planning for room air conditioners:

Basic Performance, Design Characteristics, by M. A. Clark, senior development engineer, York Corp., York, Pa.

Styling, C. A. Peterson, design consultant, Williamsport, Pa.

Special Features, W. L. McGrath, Carrier Corp., Syracuse, N. Y.

Marketing, J. R. Hartman, chairman, commercial section, E. E. I., Cincinnati, Ohio.

In addition, these papers were presented at technical sessions of the convention.

Turbo Expanders for Low Pressure Refrigeration, A. M. G. Moody, The Trane Company, LaCrosse, Wis., and L. C. Claitor, Elliott Company, Inc., Jeannette, Pa.

Combined Heat Transfer and Vapor Diffusion—The Wet Bulb Process by Electrical Analogy, C. F. Kayan, head, Department of Mechanical Engineering, Columbia University, New York, N. Y.

Application of an Electric Analogue to Domestic Refrigerator Cabinets, P. E. Davey and J. G. Spooner, General Electric Company, Erie, Pa.

Effect of Different Pulldown Methods on Heat Flow Rates With Rapid Temperature Changes in Enclosed Spaces, Neil E. Hopkins and John J. Seelaus, York Corp., York, Pa.

Two technical sessions were devoted to the domestic refrigerator and one to an insulation conference.

• **AUTOMOBILE AIR CONDITIONING.**—Considerable interest was displayed in the symposium on automobile air conditioning in which the following representatives of companies in the automotive field participated: J. W. Duhn, Chrysler Corp.; A. A. Kucher, Ford Motor Company; O. G. Tinkey, Anchor-Temp Company; S. Landell, Oldsmobile Division, General Motors Corp.; H. Schjolin, GMC Truck and Coach Division, General Motors Corp.

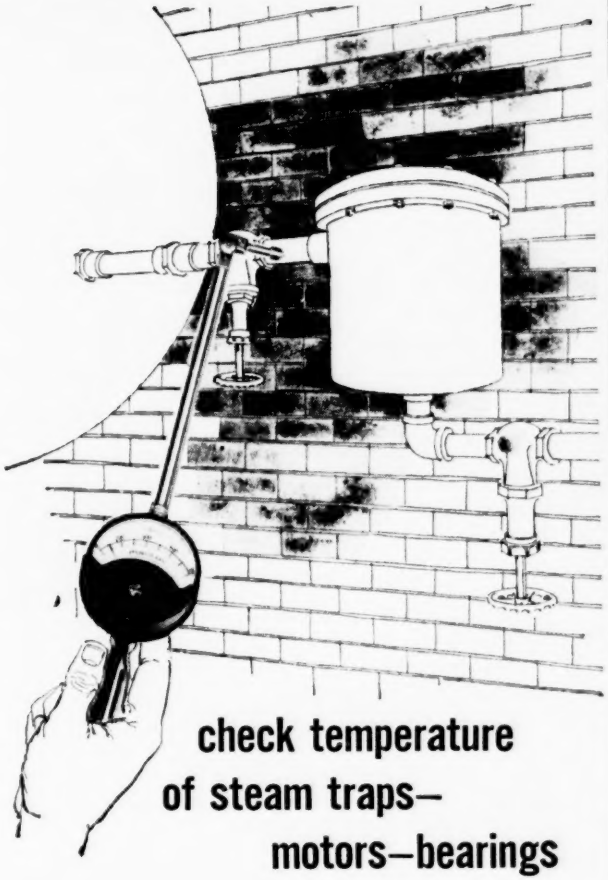
In the air conditioning of automobiles, car temperatures are maintained at from 72 to 75F, which is well below design conditions for room cooling. It was reported that Ford was leaning to the use of Solex glass on Lincoln, Mercury and Ford cars to cut down on radiant heat. Use of outside windshield sun visors is recommended to cut down on such heat.

The Oldsmobile 1953 model has overhead air distribution ducts made of reinforced Fiberglas to run the full length of the car above the doors. Ducts will be linked with evaporator and blowers by plastic perforated pipe to provide even air distribution. Four airplane type vents can be manually operated to direct cool air to passengers.

The cooling unit made by Frigidaire consists of a rotary compressor at the right side of the engine, run by a pulley off the crankshaft, a condenser in front of the radiator, an evaporator unit and blower in the rear

(*Continued on page* 138)

New officers of ASRE. Left to right, C. M. Ashley, treasurer, Leon Buehler, vice president, A. J. Hess, senior vice president, and R. C. Jordan, president



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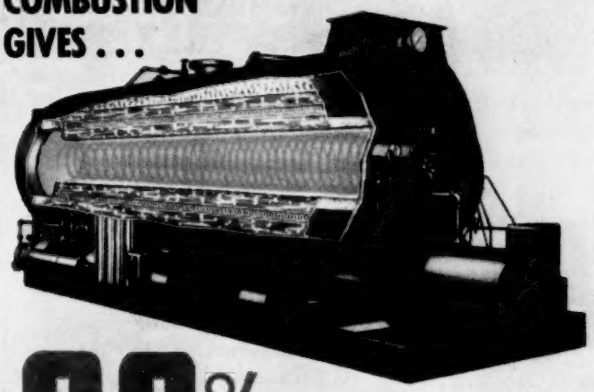

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ASRE CONVENTION

(*Continued from page* 136)

trunk compartment. Two intake scoops are installed above the rear fenders near the lower edge of the window.

• **OFFICERS.**—New officers are president, Richard C. Jordan, professor and head of mechanical engineering department, University of Minnesota; senior vice president, Arthur J. Hess, member of firm, Hess, Greiner & Polland, consulting engineers, Los Angeles, Calif.; vice president, Leon Buehler, Jr., chief refrigeration engineer, Creamery Package Manufacturing Company, Chicago, Ill., treasurer, C. M. Ashley, director of development, Carrier Corp., Syracuse, N. Y.; executive secretary, M. C. Turpin. The national directors are J. R. Hornaday, chief engineer, Deepfreeze Appliance Division, Motor Products Corp.; H. F. Spoehrer, vice president and treasurer, Sporlan Valve Co., St. Louis, Mo.; Cecil Boling, president, Bush Manufacturing Company, W. Hartford, Conn.; W. H. Volker, manager, electric appliance service, Consolidated Gas Electric Light and Power Company of Baltimore; W. R. Woolrich, dean, College of Engineering, University of Texas; W. O. Walker, director of industrial chemical research and professor of chemistry, University of Miami.

Gurdon Munger, Los Angeles, Calif., has been appointed technical secretary to fill the post vacated by Charles E. Oberst.

• **AWARDS.**—The Wolverine Award for the best paper of the year was presented to Dr. Daniel C. Schiavone, The Linde Air Products Company, for his paper Friction Factors of Dessicants in Refrigeration Systems.

The prize for the best section paper award went to A. B. Newton, vice president, Acme Industries for his paper Application and Control of Shell and Water Cooled Equipment.

The Chicago Trophy for the section obtaining the greatest percentage increase in membership during the year was presented to the Indianapolis section by Leon Buehler, chairman, Membership Committee.

• **COMING MEETINGS.**—The spring meeting of the ASRE will be held at the Lake Placid Club, Lake Placid, N. Y., June 27 to July 1, 1953. The 1953 winter meeting will be held in Washington, D. C., the spring 1954 meeting at Seattle, Wash., and the winter 1954 meeting, Philadelphia, Pa. This meeting will help celebrate the 25th anniversary of the Philadelphia section and the 50th anniversary of ASRE.

COAL RESERVES

are greater than recent estimates indicate, according to H. J. Rose of Bituminous Coal Research, Inc.

The potential tonnage of U. S. coal is much greater than some recent estimates indicate according to H. J. Rose, vice president and director of research of Bituminous Coal Research, Inc.

In a paper presented at a symposium on fuel reserves during the recent Engineering Centennial in Chicago, Dr. Rose answered recent claims that sweeping downward revisions were needed in estimates of U. S. coal reserves. He indicated not only that recent estimates of coal in the ground were less than actual reserves, but that estimates of the proportion which would be minable in the future were improperly based on existing conditions.

• **FACTORS TO CONSIDER.**—The total amount of coal that will ultimately be mined, and the length of time that coal reserves will last will be affected by unknown economic factors and research developments in the future. Factors affecting the amount of coal which will be ultimately recovered include:

1. The absolute amount of coal which is in existence. For practical use, such information should be classified according to bed thickness, depth, rank, quality, mining conditions and location.
2. The theoretical upper limit energy reserve standpoint alone, which could at any future date be mined and used.
3. Fuel competition, economic factors and social conditions which have an effect on the percentage of coal recovered in mining operations, and in determining whether less favorable coal deposits can be commercially developed.
4. Commercial mining, preparation and transportation of coal from less favorable deposits depend in part on the solution of various technical problems.

• **COAL RESERVES CHALLENGED.**—Statements that total U. S. coal reserves would last for several thousand years if mined at the present rate have been generally accepted until the past few years. Recently such estimates have been challenged as to: the total tonnage of coal in the ground; the percentage of coal that will ever be produced; the coal requirements of the future; the character and location of coal reserves with respect to future markets.

Some of the studies of the past five years have proposed sweeping downward revisions in the tonnage of recoverable coal reserves, combined with greatly increased future demands for coal.

Concern has also been expressed about future availability of particular kinds of coal with respect to present centers of consumption for such coals.

It is important to re-examine and to revise from time to time, the estimates of reserves of recoverable fuels, and estimates of how fast these reserves may be depleted in the future.

The U. S. Geological Survey and U. S. Bureau of Mines have set up improved criteria for estimating coal reserves and are working systematically to extend the knowledge.

• **MORE INFORMATION NEEDED.**—It is only natural that widely varying estimates of coal reserves have been made. Basic data on the actual quantity and quality of coal and other fuels in the ground are still inadequate.

Not only are the total fuel reserves unknown, but the percentages which will be used eventually are even more speculative.

Conclusions of various estimators have varied widely because of the purposes and viewpoints of each, and how well each was acquainted with the essential details of the data from which the long-range assumptions were made.

(*Continued on page* 140)

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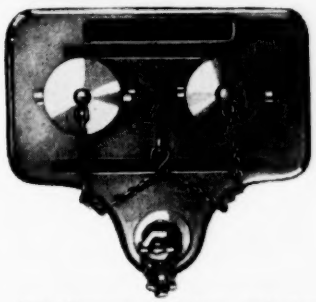
First in Interior Fire-Protection Equipment

CONCEALED or FLUSH type SIAMESE



This Siamese minimizes projections from face of building. Body, with two independent self-closing clapper valves, can be inside or even built into wall. Extra heavy bronze, lasts for life of building. Siamese (inlet for F. D.) or wall hydrant (outlet for F. D.), with or without sill cock, full range of sizes. Complete line of standpipe equipment.

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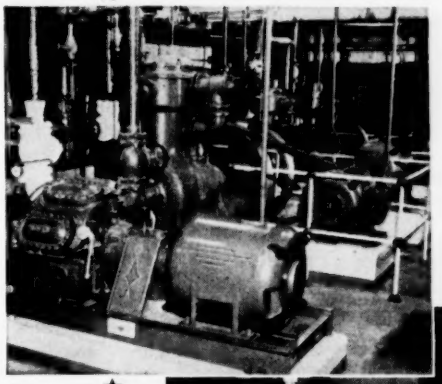

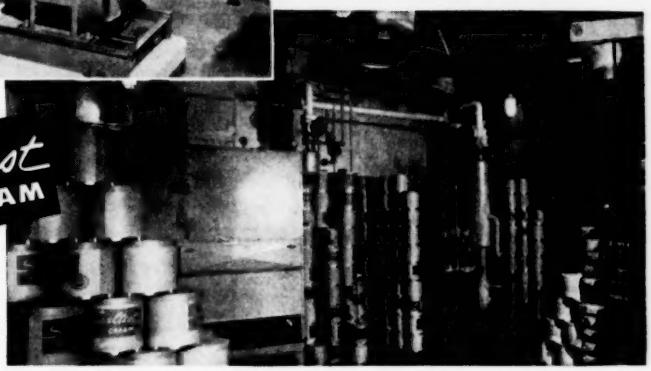

Telling's Sealtest Ice Cream is a household name in Cleveland, Ohio. The Telling Ice Cream Company—a Division of National Dairies—is one of the old timers in the business. At Tellings, it's Vilter that's the familiar name. As far back as 1916 Vilter horizontal compressors were working for Tellings.

Today, Vilter still means refrigeration in the Telling plant. Three of the four old horizontal machines have been replaced by new Vilter compressors, and other Vilter compressors and boosters have been added as Telling's capacity has been increased. Now there are six newer Vilter compressors installed there . . . including a Vilter VMC Booster, and not counting the old, and still usable horizontal. Nine Vilter air conditioning units cool the hardening rooms.

It's an old story to Vilter when a plant stays with Vilter refrigeration and replaces old Vilter equipment with new after it has lived its long, useful life. The reason? Lower operating and maintenance costs, less down time, almost entire freedom from failure. Vilter's record is in the books of thousands of plants to prove it.

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COAL RESERVES

(*Continued from page 138*)

• **SOME COAL NOT COUNTED.**—Dr. Rose pointed out that even the U. S. Geological Survey, which generally assumes greater coal reserves than other estimates, excludes many coal deposits. For example, this survey includes only those coal seams thicker than 14 to 30 inches (depending on the rank of coal and locality) and less than 3,000 feet deep.

Also, coal-bearing areas where present geological data are insufficient for making tonnage estimates have largely been omitted. For example, Wyoming is one of the leading states in coal reserves yet 53% of its coal-bearing area is omitted for lack of sufficient information.

Dr. Rose indicated that more seams would be mined than are considered economical under present conditions and that technical advances and more information about coal-bearing areas will make it practical to recover coal not currently included in any estimates. Thin-seam and very deep mining in Belgium and elsewhere in Europe show that such coal can be recovered if necessary.

• **FUTURE.**—When it appears that a certain mineral deposit will not justify commercial development for a generation or more, a mining engineer may advise his clients that from their present standpoint it is practically worthless. As a result, there has been a strong tendency in some quarters to drastically reduce coal reserves to the level of deposits which could be worked at a profit under conditions fairly similar to the present.

Such viewpoints largely or completely discount huge reserves which are not commercially attractive today, but which can and will be produced in the future whenever the economics become favorable. In many cases, technical solutions to the problems of thin or deep coal deposits, difficult mining conditions, and upgrading off-quality coal have already been worked out and have become established commercially in other countries. Further improvements are being made continually.

INDUSTRIAL HYGIENE FOUNDATION

examines industrial environment from all angles in 17th annual meeting at Mellon Institute, Pittsburgh.

The Industrial Hygiene Foundation was host to more than 600 representatives from member companies at its 17th annual meeting, November 19 and 20, which included a day of medical, legal, chemical, and engineering conferences at the Mellon Institute in Pittsburgh. On the second day was a general meeting featuring the role of industrial hygiene in production and health. Arrangements were under the direction of Dr. C. Richard Walmer, managing director of the Foundation.

• **LEGAL.**—Technical conferences on the opening day were attended by specialists in industrial medicine, law, engineering, chemistry and toxicology. Each session featured a panel discussion. Industrial noise was the subject of the legal conference with participants from member companies. The effects of noise on the worker and the cost to industry were discussed by Sam L. Hooper of Remington Rand, Inc., past president of the American Noise Abatement Council. The legal aspect of industrial noise includes the status of noise as a nuisance making the creator liable to damages, and the possibility of physical damage to the hearing of personnel as a compensible injury.

• **CHEMICAL.**—Discussion at the chemical-toxicological conference centered around gases encountered in fires and hot processes. Dr. H. F. Smyth, Jr., and Dr. H. H. Schrank jointly presided over the session. The morning program was opened by Dr. William P. Yant of Mine Safety Appliances Company who introduced the subject of fire gases and their effects by outlining types of gases that occur incidental to the burning of various materials. Other speakers were L. B. Berger of the U. S. Bureau of Mines who discussed the decomposition products of plastics; H. H. Fawcett who suggested features of a planning program for protection against fire causes. At an afternoon session, T. F. Hatch, University of Pittsburgh, led a discussion on appraisal of dust hazards. Frank A. Patty of General Motors Corp. described the uses of specialized laboratory equipment in solving industrial hygiene problems. D. D. Irish of Dow Chemical Company led a discussion of safety and health measures related to the industrial use of compounds containing chlorine, bromine and iodine (aliphatic halogenated compounds).

• **ENGINEERING.**—The Engineering Conference was under the chairmanship of Dr. Philip Drinker of the Harvard School of Public Health. A round table discussion on control of metal fumes was led by C. W. Schwenzfeier, Jr. Methods of industrial noise suppression were outlined by Dr. Allen Brandt, Bethlehem Steel Co. Recent developments and present status of air pollution was covered in a discussion led by W. C. L. Hemeon. At an afternoon session, a paper on stream pollution was presented by V. G. MacKenzie. This paper was followed by a series of short discussion of various subjects including air supply, industrial odors, dust control, and air handling.

• **GENERAL.**—Keynote address for the general meeting on November 20 was by L. R. Boulware, Vice President of General Electric Company. Mr. Boulware outlined the duties of industrial hygiene specialists not only in their contribution to industrial hygiene but also through other contacts with work and away from work.

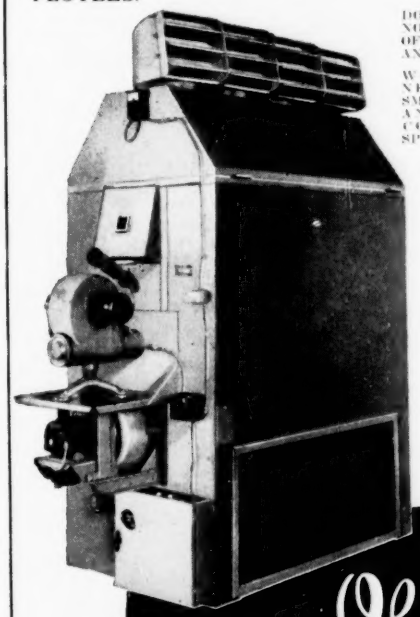
• **AIR POLLUTION.**—At an afternoon general meeting, a review of latest developments in outdoor air pollution was presented by W. C. L. Hemeon, engineering director of the Industrial Hygiene Foundation. Mr. Hemeon pointed to recent events in various cities emphasizing increasing attention to air pollution on the part of the general public. It was pointed out that the nuisance rather than health aspects of air pollution are of increasing importance. Characteristics of industrial smoke are changing under influence of improved combustion equipment and changes in fuels. The dense, highly visible clouds of very fine coal smoke which characterized industrial discharges a few years ago have been replaced by the heavier, almost invisible particles characterizing

(*Continued on page 142*)

I LIKE MY JOB BUT-

I LIKE MY JOB BUT I CAN'T STAND THAT COLD BLAST EVERY TIME THE HEATER STARTS.

OLSON, THROUGH THE USE OF A SEPARATE INDUCED DRAFT FAN, ELIMINATES THE OBJECTIONABLE COLD AIR BLAST AT EVERY START. PERSONNEL DIRECTORS SAY THAT THIS FEATURE IS ESPECIALLY APPRECIATED BY EMPLOYEES.



DOLLAR FOR DOLLAR, NO OTHER HEATER OFFERS AS MUCH AS AN OLSON HEATER.

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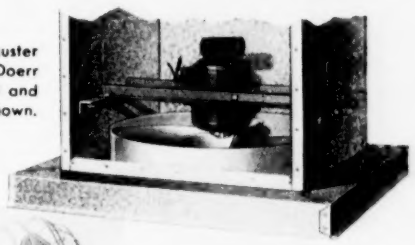
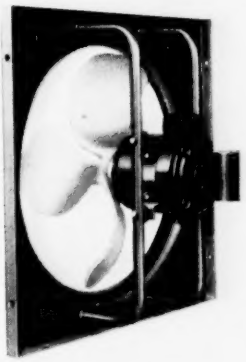
• Over ten years ago Airmaster Corporation of Chicago began using our motors. We were then known as Electro Machines, Inc. We are proud to have retained our position as their foremost motor supplier during these years, and have steadily expanded our line to meet their ever-increasing needs.



Airmaster roof exhauster powered by Doerr motor. Top hood and louvers not shown.

Airmaster 24" pedestal fan driven by 2-speed motor with pull chain switch.



Direct drive 24" exhaust fan with permanent split capacitor motor.

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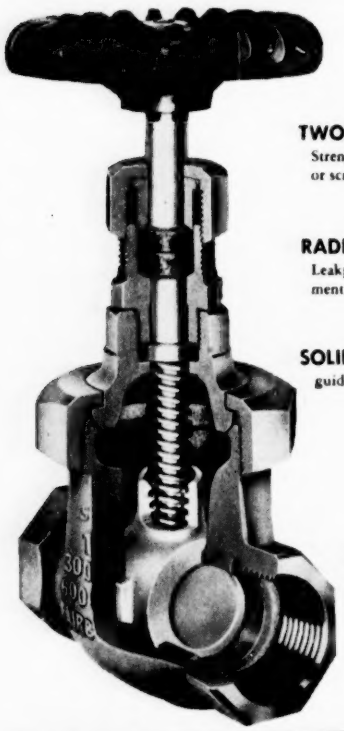

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Leakproof body-bonnet joint, rigid alignment.

SOLID NICKEL ALLOY WEDGE
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Fig. 0260 BRONZE GATE VALVE—
NON RISING STEM
300 lbs. steam working pressure at 550° F
(0264—BRONZE GATE VALVE—RISING STEM)

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INDUSTRIAL HYGIENE FOUNDATION

(*Continued from page* 140)

present day fly ash. Conversion of locomotives, residences, and other users to oil combustion has added an oily film deposit to the nuisances caused by air pollution. With the changing character of contaminating discharge, some shift in methods is suggested in air pollution control techniques. A visible stack emission may or may not represent a significant contribution to dust fall. Hence, some public re-education is required if intelligent laws are to be enacted.

WEATHER TREND

indicates warmer winters for northern regions. This season continues trend despite contrary prediction.

The weather is a never ending source of speculation and comment, and the current season is no exception. Several authorities predicted earlier this fall that we were about to experience a return of old fashioned winter weather, and even those who correctly predicted the series of abnormal winters through which we have passed, joined in forecasting a reversal this season.

What has actually happened so far has brought but little cheer to the fuel industries, according to an Anthracite Institute Bulletin. October started out well enough, taking New York City as a convenient yardstick, but in the last week of that month it started to warm up and, with the exception of a few days early in November, it was warmer than normal until the 28th. The cold snap which then developed only lasted until December 3rd, and ensuing weather was above normal.

Last year, a warm spell commenced November 28th and lasted until December 12th, but the coldest day of the winter came five days later.

• **HEAT DEMAND.**—The following table, showing the heat demand in New York for the twelve months ended November 30 in each of the past ten years, discloses that it has been less than normal in the last eight, although there have been sharp reversals between the successive years.

Year Ended Nov. 30	Degree Days in New York	Degree Day Demand for Heat vs. Normal	vs. Previous Year
1943	5,499	+ 4.1%	+13.4%
1944	5,290	+ .2%	— 3.8%
1945	4,988	— 5.5%	— 5.7%
1946	4,710	—10.8%	— 5.6%
1947	5,098	— 3.4%	+ 8.2%
1948	5,231	— .9%	+ 2.6%
1949	4,289	—18.8%	—18.0%
1950	4,721	—10.6%	+10.1%
1951	4,736	—10.3%	+ .3%
1952	4,624	—12.4%	— 2.4%
10 Year Avg.	4,919	— 6.8%	

Taking the months of September, October and November as a whole, there has not been a normal demand since the fall of 1943. The average has been 11.6% less than normal.

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Sixty-seven years have seen much history — wars, booms, depressions — and the rise and fall of many industrial organizations. In the case of Fitzgibbons, these years have meant steady growth in plant facilities and boiler making experience, new, improved and highly regarded products. And now—

THE YEAR IS 1953 and Fitzgibbons is starting not only with a modernly equipped plant, but also with a larger, more highly specialized organization dedicated to renewed attention to the "little things" of boiler building and service to customers, as well as to the broad tradition of quality which has always been the most notable Fitzgibbons characteristic.

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- **New Catalogs**

Circle the item Numbers in which you are interested and print clearly your name and address with title.

NEW CATALOGS

FLEXIBLE TUBING CATALOG

Catalog C2-3, a 4-page bulletin describing a complete line of flexible tubing, in diameters from less than 1 to 30 inches, is available from Flexible Tubing Corp., Guilford, Conn. Advantages of ducting made of fabric supported rubber or plastic wound on helical spring wire coils are listed and various uses of the tubing including its use as ducting, are described. The catalog also includes information on tubing for special applications. . . . . **Item 28**

DIAL THERMOMETER CATALOG

A 30-page catalog covering its vapor tension dial thermometer line has been published by Marsh Instrument Co., Skokie, Ill. The catalog is designed in such a manner that complete specifications, including descriptive matter, line drawings, templates and dimensional charts are listed for each individual dial size and type. . . . . **Item 29**

INDUSTRIAL WASTE TREATMENT

A guide for the treatment of industrial wastes has been published as Bulletin 4 by B-I-F Industries, Providence, R. I. The 8-page bulletin contains tables showing the different types or combinations of unit treatment processes for more than 50 wastes and the equipment used in the processes. Included are a two page flow diagram showing how the various treatment processes and equipment may be combined to treat mixed wastes and installation photos. . . . . **Item 30**

INDUSTRIAL WATER ANALYSIS

A 57-page booklet on industrial water analysis has been published by E. F. Drew & Co., Inc., New York, N. Y. It covers boiler water sampling, expressions of results, test equipment, and general water analysis. The book also outlines tests for versenate hardness, dissolved oxygen, total solids, steam purity by conductance, and corrosion tests by NDHA methods. It is priced at $1.00. . . **Item 31**

ELECTRIC COMFORT HEATERS

Electric comfort heaters of every type, size and rating are described and illustrated in a new 8-page catalog, No. D-52, covering its Chromalox line, and issued by Edwin L. Wiegand Co., Pittsburgh, Pa. A quick selector chart shows how to calculate heat requirements for given areas and types of building construction. The catalog lists 75 different models of forced air, convection and radiant heaters in capacities of ¼ to 100 kw. Dimensions, capacities, and uses are given. . . . . **Item 32**

CORROSION RESISTANT FITTINGS

Bulletin 314 on corrosion resistant welding fittings has been published by Welding Fittings Corp., New Castle, Pa. The 28-page booklet lists the specifications, applications, and available sizes and types of Flowline stainless steel, monel, nickel, and Inconel fittings. Also included are diagrams and illustrations of the various types of fittings and their uses. . . . . **Item 33**

AUTOMATIC CONTROL BULLETIN

Bulletin No. 3500, a 4-page folder covering its Type M Autocon Selectrols which are used for water, sewage, irrigation and flood control systems, is available from Automatic Control Co., St. Paul, Minn. Typical operating schedules and a complete range of units with typical installation plans are included, along with dimensions and typical specifications. . . . . **Item 34**

DUST COLLECTION BULLETIN

High efficiency dust collection in woodworking plants is the subject of bulletin No. 382 published by American Wheelabrator & Equipment Corp., Mishawaka, Ind. It shows how Dustube cloth-tube-type collectors are being used in industrial installations to improve plant housekeeping and reduce certain operating costs at the same time. Another feature illustrated is that collected wood dust can be channeled to the boilers and used for fuel. . . . . **Item 35**

QUENCH OIL COOLING EQUIPMENT

Catalog No. FB-1052, on its self-contained quench oil cooling equipment is revised by Bell & Gossett Co., Morton Grove, Ill. Dimensional information and selection data on the Kleenwell strainer and dimensional information on the P-30 Perambulator and the Junior Quencher are now included along with a cross reference to equipment for heat treat or metal working plants. . . . . **Item 36**

TOTALLY ENCLOSED MOTORS

A 10-page bulletin, No. 1784, including complete information regarding its new totally enclosed explosion proof motors is issued by U. S. Electrical Motors Inc., Los Angeles, Calif., and Milford, Conn. Booklet contains colored illustrations and diagrams of each of its units accompanied with descriptions of each. A 2-page cross sectional colored diagram explains the operation and special features. Applications of the motors also are described. . . . . **Item 37**

VACUUM HEATING PUMP GUIDE

An 8-page guide to its vacuum heating pumps is issued as Bulletin H-52 by Whittington Pump and Engineering Corp., Indianapolis, Ind. It features the new two motor single and four motor duplex units, the former Series 2 and the latter Series 4, which have a suction pump which cannot lose its prime. A description of the design and operation of these units is included with a table containing number, EDR rating, vacuum pump ratings, boiler feed pump ratings, and rpm. Also described are electric and electric-steam turbine models. Specifications, diagrams, operating principles, dimension and weight charts, and capacity charts are also given. . . **Item 38**

AIR DISTRIBUTION PRODUCTS

Bulletin F 4471-1, describing its line of air distribution products, is published by Barber-Colman Co., Air Distribution Div., Rockford, Ill. The 4-page bulletin illustrates and describes several types of grilles and registers, outlets, diffusers, controls, and accessories. Diagrams and illustrations of smoke patterns are included. . . . . **Item 39**

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FINNED COIL CATALOG

A catalog covering its complete line of finned coils, including water, direct expansion and steam (both standard and non-freeze), is published by Bush Mfg. Co., West Hartford, Conn. Featured in the new catalog are pre-engineered coils in stock sizes rated at standard conditions. The booklet contains specifications on all types of its coils, as well as engineering and construction data which simplifies specifying and ordering. . . . . **Item 40**

WROUGHT IRON PIPE

Five tests for the positive identification of wrought iron pipe are described in a brochure published by A. M. Byers Co., Pittsburgh, Pa. The identification booklet also tells why recognition of piping material is important and explains how to protect against the use of substitutes. The tests covered are nick fracture, manganese content, macroscopic test, microscopic test, and markings on pipe. . . . . **Item 41**

SPECIAL PURPOSE PUMP MANUAL

A bulletin covering special purpose pumps and related products is published by C. A. Dunham Co., Chicago, Ill. Subjects discussed are centrifugal pumps, airline pumps, unassembled condensation pumps, flash tanks, lift fittings, vacuum breakers and check valves. All these products are explained and illustrated in this 24-page booklet, Application Manual No. 2495. Designed as a supplement for the firm's heating products catalog, the manual will serve as a guide for those who specify, sell and install this type of equipment. . . . . **Item 42**

PURIFIERS AND SEPARATORS

Bulletin 501 on its line type Hi-eF purifiers is announced by Purifier Div., The V. D. Anderson Co., Cleveland, Ohio. Well illustrated, this folder explains how these units keep moisture and dirt out of paint spray equipment, air tools, chucks, and other pneumatic equipment; how they clean up steam; and how they remove water and oil from gas lines. Installation photos illustrate equipment arrangement and blueprint drawing shows piping layouts. Selection tables, dimensions, capacities and prices are also included in the 8-page bulletin. . . **Item 43**

HOSPITAL VENTILATION GUIDE

Release of its new bulletin No. 1510 on modern practices in hospital ventilation is announced by Ilg Electric Ventilating Co., Chicago, Ill. General hospital ventilating needs are explained and recommended air changes are listed. With the use of photographs, each solution of a particular hospital ventilating problem is shown. Represented are installations now working in hospitals. . . . . **Item 44**

SALES AND PLANT OPERATIONS

A 26-page booklet describing its new sales office is released by Reynolds Metals Co., Louisville, Ky. The booklet, containing many illustrations, is designed as a guide to the sales and plant operations carried on in the main sales office and six plants located in Louisville. The main sales office is illustrated and described to show the uses of aluminum in an office building. . . . . **Item 45**

GROMMET V-BELTS

Bulletin 20B6497A on its Texrope grommet v-belt is available from Allis-Chalmers Mfg. Co., Milwaukee, Wis. According to the bulletin, the belt is a cool running, shock absorbent, and offers little slip and much grip. Cross section illustrations show how the grommet v-belt provides a high gripping pressure under all load conditions. . . . . **Item 46**

INDUSTRIAL STEAM TRAP

Bulletin No. 351 featuring a new Type D thermostat bellows steam trap recently added to its line is issued by W. H. Nicholson & Co., Wilkes-Barre, Pa. This trap is smaller in size, capacity and price than other types made by this company, and is intended to meet requirements for a smaller trap. Pamphlet describes applications, construction, and operation of the valve, and lists prices, dimensions, and capacities. . . . . **Item 47**

PLASTIC PIPE BOOKLET

A 16 page brochure on plastic pipe, containing all pertinent information on its four types of pipe, flexible, semi-rigid, rigid high impact, and rigid polyvinyl chloride, is announced by Triangle Conduit and Cable Co. Inc., Plastic Products Div., New Brunswick, N. J. Detailed tables give chemical and physical characteristics of each type. Also included are advantages of using plastic pipe and simple directions on how to install and join the pipe. . . . . **Item 48**

ELECTRONIC AIR CLEANERS

Catalog E-60, a new 12 page book on electronic air cleaners is available from Trion, Inc., McKees Rocks, Pa. The book contains history, principle of operation, aerosol chart, filter test methods, engineering data, equipment photographs, and suggested specifications for electronic air cleaners. It is available, free of charge, upon request. . . **Item 49**

AXIAL VANED FANS

Bulletin J-611, describing its Series 1000 Axivane fans is now available from Joy Mfg. Co., Pittsburgh, Pa. This 16-page bulletin explains the advantages of vaneaxial design and the versatility accorded by adjustable blades, for all commercial and industrial applications. The Series 1000 line consists of 136 models, ranging from 18 to 84 inches in diameter and producing volumes up to 150,000 cfm at total pressures as high as 11.0 inches wg. Fans are available in 19 housing diameters, 4 hub sizes and 5 motor speeds. Photographs of typical installations are included, as well as information about special duty units and other fans. Specification tables showing volume and pressure capacities and physical dimension components are also contained in this bulletin. . . **Item 50**

BOILER WATER FEEDERS

A condensed catalog and price list which concentrates on the more popular of the company's products, covering boiler water feeders, low water fuel cut-offs, pump controls and relief valves—including the recently announced temperature relief valves and combination T & P relief valves, in both regular and dip tube models, is issued by McDonnell & Miller, Inc., Chicago, Illinois. This 8-page catalog No. C-49, has information arranged to simplify selection of proper equipment, and is complete with prices. Discount sheets have also been published, showing contractors' and wholesalers' discounts. . . . . **Item 51**

METAL FRAMING CATALOG

A new 83-page catalog, No. 800, covering its complete line of metal framing products is announced by Unistrut Products Co., Chicago, Ill. The pocket catalog is designed as a reference and guide for anyone concerned with the use, specification, or purchase of metal framing systems, channels, nuts, bolts, screws, clamps, hangers, supports, inserts, and brackets. Each item is listed with complete data and illustrations. Diagrams show typical applications. Design load data are also included. . . . . **Item 52**

SURFACE DEHUMIDIFIERS

Catalog 1660, a 32-page bulletin describing completely surface dehumidifier units used to control humidity in large commercial and industrial buildings is available from the Westinghouse Electric Corporation's Sturtevant Div., Boston, Mass. Five pages are devoted to details of construction of the dehumidifiers along with discussions on how surface cooling and evaporative cooling are put to work in the units. The booklet also presents a tested procedure for determining the size, giving all the formulae, unit data, psychrometric data, and coil data necessary to calculations. Three sample problems are worked out as an aid in explaining the procedure. The latter part of the catalog gives information necessary for installation and erection of the dehumidifiers, outline dimensions, and erection instructions. . . . . **Item 53**

GAS CONTROLS MANUAL

A 160-page manual on the service and installation of its line of automatic heating and industrial gas controls and systems is issued by General Controls Co., Glendale, Calif. Divided into seventeen sections, it covers different controls, thermocouples, pilot burners and generators, relays, regulators, valves, and systems. Various models are listed under each general heading, and the unit is illustrated or diagrammed, data are given, and description, operation, and installation explained. The booklet is priced at 50 cents. . . . . **Item 54**

PLEASE SEND US MORE INFORMATION. Circle below item numbers on which you wish further information.

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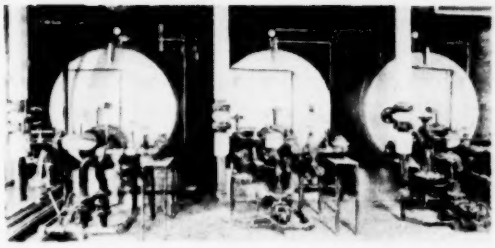

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Proved in long-time service in thousands of installations—in laundries, hotels, institutions, commercial buildings and general industry—**p-k** hot water storage heaters are the most dependable your money can buy—to save you money.

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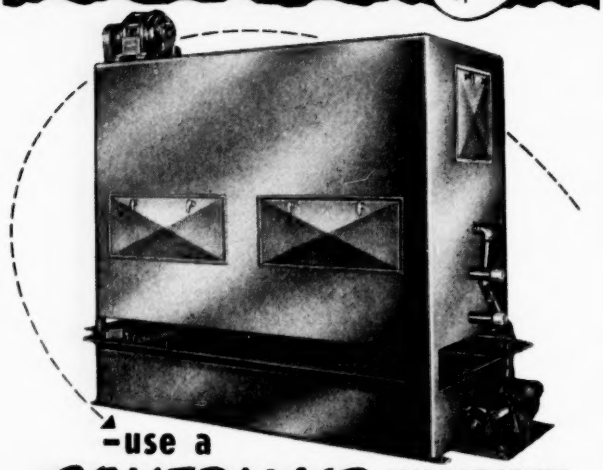
When water is a *Headache...*



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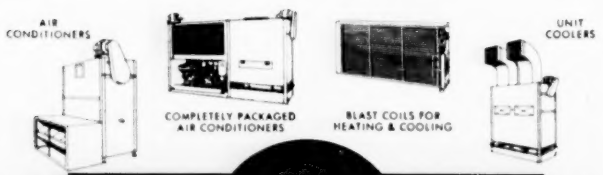

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(*Continued from page* 130)

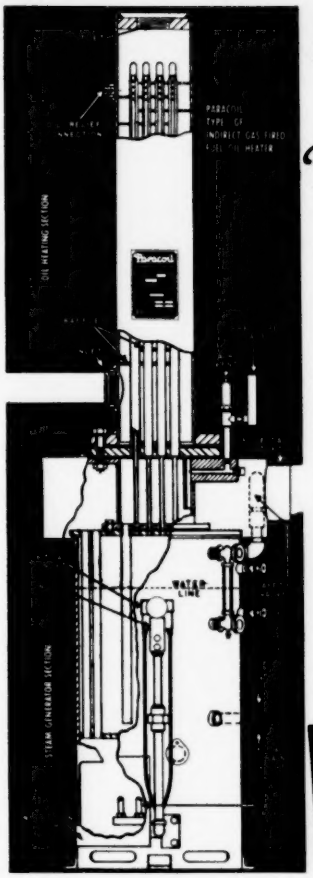
supplied with a complete text and after assigned study will submit a written report on each assignment, which is then corrected, criticized and returned to the student. The complete course can be completed in one year. Institute of Gas Technology, 17 West 34th St., Chicago 16, Ill. Price, complete text, $37.50.

How to Reduce Stack Dust—This is the second of a series of Aid to Industry booklets to help users get maximum results from coal and to help coal producers expand their markets. In this booklet, particular attention is given to plants up to about 300 boiler hp. Factors influencing the quantity of solids in stack gases are reviewed and suggestions given that will aid in lower cinder and fly ash emission. How To Reduce Stock Dust From Small Stationary Plants is a 12-page booklet with many illustrations, charts and tables. Bituminous Coal Research, Inc., 2609 First National Bank Building, Pittsburgh 22, Pa. Price, 40 cents per booklet.

Commercial Standard for Gas Floor Furnaces—This is a revised commercial standard for gas floor furnaces gravity circulating sype. This standard, idenified as CS99-52, has been adjusted to conform to applicable sections of the American Standard for Installation of Gas Piping and Gas Appliances in Buildings. H. A. Bonnet, Commodity Standards Division, U. S. Department of Commerce, Washington 25, D. C.

Automatic Ignition Systems for Commercial Gas Cooking Equipment—Research Bulletin 65 of the American Gas Association Laboratories covers application of automatic ignition systems to commercial gas cooking equipment. Although automatic ignition systems were used on domestic gas appliances for many years, new applications were made through commercial cooking appliances. Studies were therefore undertaken to develop the necessary information on making effective and reliable applications of such ignition systems to commercial equipment. The initial study was followed by experimental work to obtain data and to develop information on automatic ignition systems with thermocouple elements. American Gas Association, 420 Lexington Avenue, New York 17, N. Y. Price, $1.50.

Capacities of Plumbing Stacks in Buildings—A report by the National Bureau of Standards on capacities of plumbing stacks in buildings summarizes previous research on stack capacities and gives an account of the attempts to define stack capacity. It outlines the problem, describes tests to determine terminal velocities and terminal length in stacks, tests on stacks and drains, and analyzes hydraulic and pneumatic conditions in a stack in a multi-story building. This Building Materials and Structures Report No. 132 suggests applications of the results of this investigation. Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price, 20 cents.



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Paracoil Keeps Pace With The Rapidly Changing Needs Of The Oil Burner Industry

The TYPE "GF" INDIRECT GAS FIRED FUEL OIL HEATER

A RADICALLY NEW APPROACH TO THE PROBLEM OF ADEQUATE OIL PREHEATING UNDER ALL OPERATING CONDITIONS!

The Type "GF" Oil Heater is an integrated self-contained steam vapor generating exchanger using gas as its primary heat source.

However, the gas flame does not come in contact with the tubes containing the fuel oil. Instead, vapor from the lower steam generating section does the actual oil heating!

APPLICABLE TO ALL TYPES OF OIL FIRED APPARATUS!

As it is not dependent upon the unit it is servicing for the means of heating the oil, the Type "GF" Heater can be applied to any oil fired apparatus, be it a steam or hot water boiler, a process oven, a dryer or a kiln!

A COMPLETE SOLUTION TO THE OIL-IN-BOILER PROBLEM!

As the Type "GF" Heater is in no way connected to the steam or water space of any boiler it may be serving, there can be no possible contamination of the boiler heating surfaces in the event of an oil leak in the heater.

CHECK THESE FEATURES!

Completely factory assembled • Easy to install anywhere, even outdoors • Requires only minimum of floor space • Economical to operate • Wide range of oil heating capacities • Burns any specified type of gas fuel High oil temperatures at all times • Operation unaffected by normal variation in viscosities of oils being heated • Reduces oil consumption through improved fuel combustion.

THE PERFECT HEATER FOR:

- Low temperature forced hot water heating systems on No. 6 oil.
- Plants with starting difficulties after week end shutdowns.
- Supplementing inadequacies in present oil preheating systems.

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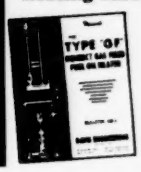

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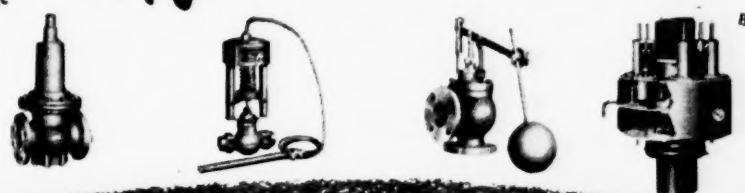

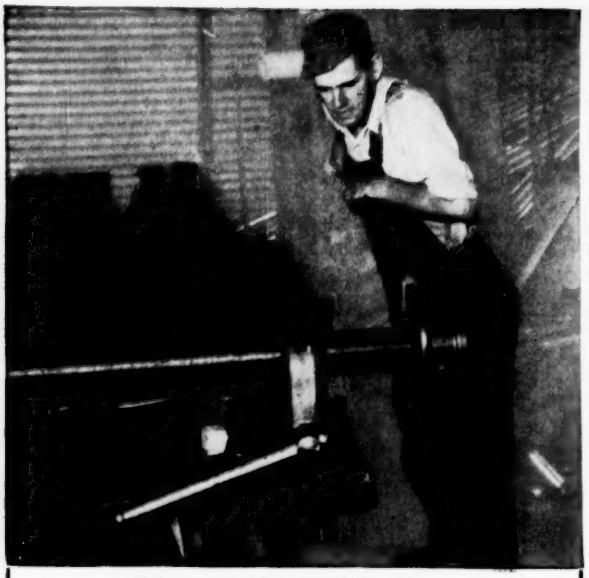

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You can be sure that "K" Fittings have the stamina to stand all the strain put on them in making up tight joints. Our metallurgists control cupola mixes to maintain tensile strength above 30,000 lbs. while the standard is 21,000 lbs.

What's more, "K" Fittings are sound and uniform. Skillful molding assures freedom from thin walls, cold cheeks, sand holes. Threads of screwed fittings are tapped full and clean. Openings are chamfered so pipe will enter easily. The faces of flanged fittings are accurately milled; bolt holes exactly spaced.

The "K" line consists of—

Standard and Extra Heavy Screwed Steam Fittings.
Standard and Extra Heavy Flanged Fittings.
Standard and Extra Heavy Companion Flanges.
Standard Sprinkler Fittings
Standard Drainage Fittings
Standard Bushings, Plugs and Flange Unions.

The "K" on a fitting is our guarantee—your safeguard.

Good workmanship sells "K" Fittings

K PIPE FITTINGS
CAST IRON AND MALLEABLE
3,000 Shapes and Sizes

Complete information gladly furnished.

THE KUHNS BROTHERS COMPANY
Dayton 1, Ohio
Established 1887
Combined marketing facilities with
Malleable Iron Fittings Company, Branford, Conn.

▫ McAndrew McCall has been named chief design engineer, Construction Dept., Machinery Div., Dravo Corp., Pittsburgh, Pa. Mr. McCall has held various engineering positions throughout the world, his last position being that of chief engineer and general superintendent of Compania Tecnica y Constructora in Mexico and South America.

• Allan W. Cox has been appointed manager of low temperature insulation sales for Owens-Corning Fiberglas Corp., Toledo, Ohio. He was district manager in the St. Louis office of cork insulation for the past four years, serving before that in the company's Seattle, Philadelphia, and New York branch offices.

• Airtemp Construction Corp., Dayton, Ohio, has announced the appointment of R. B. Stotz as manager. Mr. Stotz, former director of corporation activities in New York, Boston and Philadelphia, replaces I. C. Baker, deceased.

• John M. Bickel and Charles V. Fenn have been elected vice presidents of Carrier Corp., Syracuse, N. Y. Mr. Fenn will continue in charge of the direct sales division, and Mr. Bickel of the dealer sales division. Previously they were managers of these two divisions.

• The appointment of Paul B. Wishart to the newly created position of general manager of Minneapolis-Honeywell Regulator Company, and his election to the board of directors has been announced. Mr. Wishart has been with the firm for 11 years, and since 1945 has been vice-president in charge of manufacturing in the company's Minneapolis plants.

GETTING PERSONAL

W. Sturrock

Walter Sturrock (*Artificial Lightning and its Relation to Air Conditioning*, page 101) is an authority in the field of office lighting and was national president of the Illuminating Engineering Society during 1950-51. In 1946 he was among the first to be elected to the society's new rank of Fellow. At present he heads the Engineering Publications Section of the Application Engineering Department, Lamp Division, General Electric Company.

He obtained his M. E. degree from Cornell University and then joined the new G-E Lamp Department.

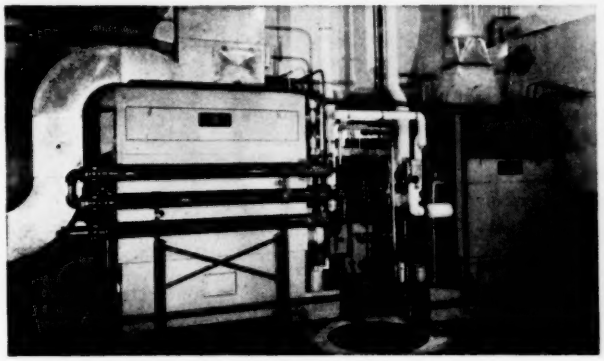
During World War I, as Engineer Officer, he was responsible for the equipment of two squadrons operating from an air base in France. For his thorough work and ability he received a citation from General Pershing. When World War II came along he served as lightning consultant to government departments in Washington.

Mr. Sturrock was formerly in charge of Nela Park's commercial and industrial lighting activity and thus gained familiarity with many different lighting problems. The Engineering Publications Section, under his direction, publishes many technical bulletins and booklets and

(*Continued on page* 150)

Niagara's HYGROL DRIES AIR BEST

with exact moisture content



NIAGARA CONTROLLED HUMIDITY AIR CONDITIONING

This method removes moisture from air by contact with a liquid in a small spray chamber. The liquid spray contact temperature and the absorbent concentration, factors that are easily and positively controlled, determine exactly the amount of moisture remaining in the leaving air. Heating or cooling is done as a separate function.

The Niagara's Controlled Humidity Method using HYGROL moisture-absorbent liquid is

Best and most effective because . . . it removes moisture as a separate function from cooling or heating and so gives a precise result constantly and always. Niagara machines using liquid contact means of drying air have given over 20 years of service.

Most reliable because . . . the absorbent is continuously reconcentrated automatically. No moisture-sensitive instruments are required to control your conditions.

Most flexible because . . . you can obtain any condition at will and hold it as long as you wish in either continuous production, testing or storage.

Easiest to take care of because . . . the apparatus is simple, parts are accessible, controls are trustworthy.

Most compact, taking less space for installation.

Inexpensive to operate because . . . no re-heat is needed to obtain the relative humidity you wish in normal temperature ranges and frequently no refrigeration is used to remove moisture.

The cleanest because . . . no solids, salts or solutions of solids are used and there are no corrosive or reactive substances.

For complete information write

NIAGARA BLOWER COMPANY

Over 35 Years of Service in Industrial Air Engineering

Dept. HV, 405 Lexington Ave. New York 17, N. Y.

Sales Engineers in Principal Cities of U. S. and Canada

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HARD-TO-HEAT AREAS

REMOTE LOCATIONS

PROBLEM INSTALLATIONS

MODEL 14-10

Suspension Type Models, 10,000 to 45,000 watts. For permanent installation where large areas are to be heated and for auxiliary heat in hard-to-heat areas. Adjustable louvers for directing fan-circulated heat where desired.

MODEL AN-30A

Combination Portable and Suspension Type Models, 1500 to 7500 watts. Smaller heaters may be plugged in temporarily wherever heat is needed or mounted permanently on swivel-type brackets. Adjustable louvers for directing fan-circulated heat where desired.

with

ELECTROMODE *All-Electric*

UNIT HEATERS

Models and Capacities To Match Requirements

PLANT • OFFICE WAREHOUSE

- Quick, Easy Installation
- No Plumbing Required
- No Wasted Heat
- Satisfied Users
- Nothing to Freeze
- For Utmost Economy can be thermostatically controlled

Completely SAFE!

Only Electromode has the sealed-in CAST-ALUMINUM HEATING ELEMENT. No danger of fire, shock or burn. Automatic safety switch prevents overheating.

Approved by Underwriters' Laboratories

For HOMES • OFFICES MOTELS • STORES

This modern design Electromode Wall-Type Heater has built-in thermostat for individual room temperature control. Fan-circulated heat is distributed by Down-Flo principle—at floor level. Easy to install in new building or remodeling. Handsome silver grey hammertone finish. Available in 1500 to 4000 watts.

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45 CROUCH STREET ROCHESTER 3, N. Y.

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☐ Electromode Industrial Heaters
☐ Electromode Domestic Heaters

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CITY _____ STATE _____

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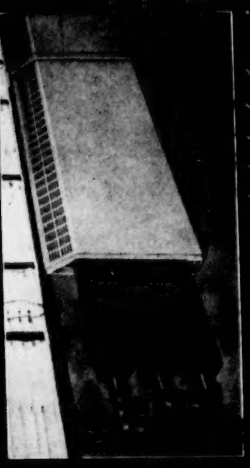

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Features...

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* AIRFOIL and CUSTOMFIT are Trade Names of

RADIANT-RAY RADIATION, INC. New Britain, Connecticut

(*Continued from page* 148)

supplies articles to the business press. He is the author of several IES papers, a contributor to many technical journals, and he has had wide experience as a lecturer.

He is active in the civic affairs of East Cleveland, Ohio, his home town.

C. H. Berry

C. Harold Berry (*Flow and Fan*, page 81) graduated from Pratt Institute in 1909 and received his M.E. at Cornell in 1912 and M.M.E. in 1916. He was instructor and assistant professor of mechanical engineering at Cornell to 1918 and served in the Army Ordnance Department 1918 to 1919. After World War I he joined Detroit Edison Company, where he had worked previous summers, and remained with the company until 1925, when he became associate editor of Power. In 1928 he became professor of mechanical engineering at Harvard University. He is a fellow of ASME and American Academy of Arts and Sciences, has been chairman of the ASME Power Test Codes Committee, and has had wide experience in consulting work on fans, pumps and other power plant equipment. The series of articles beginning in this issue grew from a set of classroom notes which were prepared and used with several successive groups of students including both engineers and chemists at various levels of prior training.

Canadian Degree-Days for November, 1952*

City	November		Cumulative	
	1952	Normal	1952	Normal
Calgary, Alta.	1018	1122	2015	2276
Charlottetown, P.E.I.	876	858	1634	1619
Crescent Valley, B. C.	1047	981	1846	2039
Edmonton, Alta.	1041	1215	2071	2406
Fort William, Ont.	1089	1143	2306	2219
Grande Prairie, Alta.	1059	1218	2106	2510
Halifax, N. S.	721	789	1353	1477
London, Ont.	774	843	1600	1477
Medicine Hat, Alta.	981	1104	1732	1972
Moncton, N. B.	906	936	1870	1813
Montreal, P. Q.	810	948	1591	1689
North Bay, Ont.	966	1017	2058	1975
Ottawa, Ont.	864	984	1769	1783
Penticton, B. C.	852	813	1476	1553
Porquis Junction, Ont.	1107	1266	2383	2462
Prince George, B. C.	1041	1068	2103	2253
Quebec City, P. Q.	933	1050	1828	1977
Regina, Sask.	1173	1355	2304	2557
St. John, N. B.	792	870	1577	1698
Saskatoon, Sask.	1131	1305	2192	2482
Toronto, Ont.	692	817	1386	1489
Vancouver, B. C.	710	657	1309	1350
Victoria, B. C.	642	462	1237	1172
Windsor, Ont.	690	795	1350	1274
Winnipeg, Man.	1113	1302	2176	2376

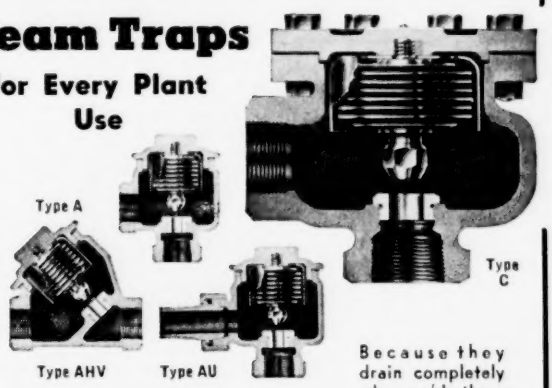
*These data are supplied through the courtesy of the Meteorological Division, Air Service Branch, Department of Transport, Canada.

NICHOLSON MAKES

FREEZE-PROOF

Steam Traps

for Every Plant Use



Because they drain completely when cold, these four types of Nicholson steam traps are positively freeze-proof. Can be freely installed outdoors. Universally recommended for use in lines which need not be in continuous use during cold weather, because they are freeze-proof and because their 2 to 6 times average drainage capacity results in minimum heat-up time. The non-air-binding feature of Nicholson traps also notably facilitates heat transfer in severe weather. Sizes ¼ inch to 2 inch; pressures to 250 pounds.

BULLETIN 152

199 Oregon St., Wilkes-Barre, Pa.

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chase out foul, wet air!

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- Easy to install
- Motor out of line of air flow — for better performance in moisture filled air.

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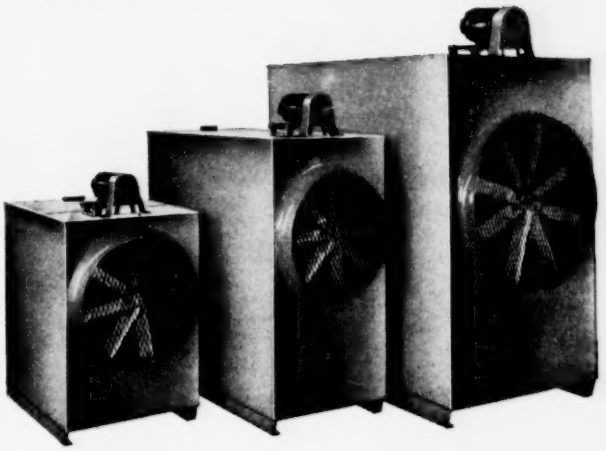

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WATER DISTRIBUTION—Gravity-type pan eliminates extra pumping head.

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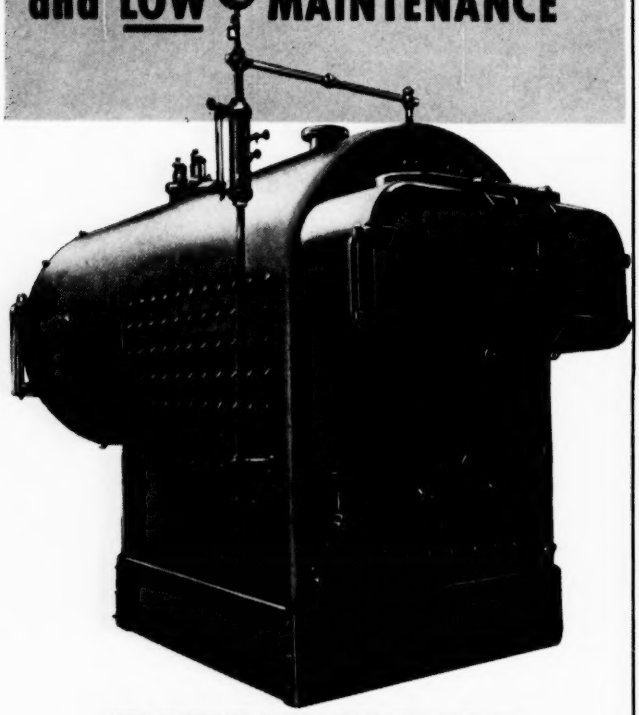
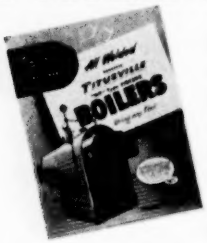


TITUSVILLE
"WP" TYPE
FIREBOX BOILERS



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Precision die formed, fusion-welded into a single-piece unit, the sturdy Titusville "WP" Boiler is designed in every detail to deliver long-lived, satisfactory heating and power service for exacting industrial and institutional requirements. ● Investigate the advantages for your application!

THE TITUSVILLE IRON WORKS COMPANY
A division of Struthers Wells
Representatives in Principal Cities
TITUSVILLE, PENNSYLVANIA

DEGREE-DAYS FOR NOVEMBER, 1952

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city.

HEATING AND VENTILATING'S 25th Year of Publication of Monthly Degree-Day Data

City	November		
	1952	1951	Normal
Abilene, Texas (A)	385	443	333
Albany, New York (A)	747	931	774
Albuquerque, New Mexico (A)	740	680	630
Alpena, Michigan (C)	797	1053	912
Anaconda, Montana (C)	1059	978	951
Asheville, North Carolina (C)	563	707	576
Atlanta, Georgia (C)	359	518	396
Atlantic City, New Jersey (C)	480	590	588
Augusta, Georgia (A)	331	447	321
Baker, Oregon (C)	963	872	849
Baltimore, Maryland (C)	457	624	567
Billings, Montana (A)	947	889	909
Binghamton, New York (C)	661	876	798
Birmingham, Alabama (A)	393	513	318
Bismarck, North Dakota (A)	1031	1247	1113
Block Island, Rhode Island (A)	563	615	573
Boise, Idaho (A)	894	784	738
Boston, Massachusetts (A)	595	665	693
Bozeman, Montana (C)	1111	727	1006
Buffalo, New York (A)	654	915	774
Burlington, Iowa (A)	685	920	(a)
Burlington, Vermont (A)	755	961	861
Butte, Montana (C)	1193	1091	923
Cairo, Illinois (C)	484	682	519
Charleston, South Carolina (C)	188	311	207
Charlotte, North Carolina (C)	411	513	426
Chattanooga, Tennessee (A)	489	621	531
Cheyenne, Wyoming (A)	1083	940	900
Chicago, Illinois (C)	605	906	696
Cincinnati, Ohio (C)	518	732	615
Cleveland, Ohio (A)	623	874	732
Columbia, Missouri (A)	621	799	911
Columbia, South Carolina (C)	269	431	324
Columbus, Ohio (C)	615	815	690
Concord, New Hampshire (A)	807	922	846
Concordia, Kansas (C)	732	799	693
Dallas, Texas (A)	347	397	303
Davenport, Iowa (C)	663	938	795
Dayton, Ohio (A)	653	864	660
Deer Lodge, Montana (C)	1186	1076	1055
Denver, Colorado (C)	971	799	759
Des Moines, Iowa (A)	776	979	798
Detroit, Michigan (A)	660	902	777
Devils Lake, North Dakota (C)	1056	1373	1179
Dodge City, Kansas (A)	729	785	672
Dubuque, Iowa (C)	801	1095	846
Duluth, Minnesota (C)	1032	1273	1074
Eastport, Maine (A)	772	802	843
Elkins, West Virginia (A)	682	896	741
El Paso, Texas (A)	459	424	381
Ely, Nevada (A)	1138	991	(a)
Erie, Pennsylvania (C)	571	817	711
Escanaba, Michigan (C)	828	1107	960
Evansville, Indiana (A)	564	772	528
Fargo, North Dakota	1020	1317	1105
Fort Smith, Arkansas (A)	506	588	408
Fort Wayne, Indiana (A)	706	931	726
Fort Worth, Texas (A)	341	399	252
Fresno, California (A)	366	278	315
Galveston, Texas (C)	168	193	60
Grand Junction, Colorado (A)	867	860	747
Grand Rapids, Michigan (A)	681	1011	774
Green Bay, Wisconsin (C)	844	1181	921
Greensboro, North Carolina (A)	490	629	492
Greenville, South Carolina (A)	386	588	450
Harrisburg, Pennsylvania (A)	608	782	660
Hartford, Connecticut (A)	671	775	705
Hatteras, North Carolina (C)	245	302	234
Havre, Montana (C)	1014	1014	1041
Helena, Montana (A)	1157	1023	948
Houston, Texas (C)	218	245	114
Huron, South Dakota (A)	934	1097	1005
Indianapolis, Indiana (A)	655	875	687
Jackson, Mississippi (A)	350	426	(a)
Kansas City, Missouri (A)	605	752	639
Knoxville, Tennessee (A)	538	662	519
La Crosse, Wisconsin (A)	800	1150	909
Lander, Wyoming (A)	1147	1002	726

(a) Data not available.

City	November		
	1952	1951	Normal
Lansing, Michigan (A)	736	1022	861
Lewiston, Maine (O)	780	876	876
Lincoln, Nebraska (C)	756	863	753
Little Rock, Arkansas (A)	448	571	381
Livingston, Montana (C)	988	884	864
Los Angeles, California (C)	201	113	123
Louisville, Kentucky (A)	538	765	552
Lynchburg, Virginia (A)	498	682	537
Macon, Georgia (A)	288	398	324
Madison, Wisconsin (C)	753	1056	891
Marquette, Michigan (C)	840	1092	960
Memphis, Tennessee (A)	469	582	402
Meridian, Mississippi (A)	357	454	312
Milwaukee, Wisconsin (A)	749	1051	846
Minneapolis, Minnesota (A)	883	1176	963
Moline, Illinois (A)	702	965	(a)
Montgomery, Alabama (A)	335	453	273
Nantucket, Massachusetts (A)	571	603	609
Nashville, Tennessee (A)	492	662	483
New Haven, Connecticut (A)	607	734	693
New Orleans, Louisiana (C)	174	260	102
New York, New York (C)	501	640	594
Newark, New Jersey (A)	549	680	463
Norfolk, Virginia (C)	338	457	411
North Head, Washington (C)	520	506	510
North Platte, Nebraska (A)	1014	902	837
Oakland, California (C)	354	289	330
Oklahoma City, Oklahoma (C)	497	647	459
Omaha, Nebraska (A)	777	909	780
Oswego, New York (C)	649	862	783
Parkersburg, West Virginia (C)	559	733	624
Peoria, Illinois (A)	670	944	789
Philadelphia, Pennsylvania (C)	487	633	544
Phoenix, Arizona (C)	236	140	156
Pittsburgh, Pennsylvania (C)	531	758	669
Pocatello, Idaho (A)	1121	934	813
Portland, Maine (A)	813	870	807
Portland, Oregon (C)	653	529	558
Providence, Rhode Island (C)	571	683	693
Pueblo, Colorado (A)	930	841	741
Raleigh, North Carolina (C)	378	532	429
Rapid City, South Dakota (A)	913	951	870
Reading, Pennsylvania (C)	574	721	669
Red Bluff, California (A)	370	354	(a)
Reno, Nevada (A)	907	742	714
Richmond, Virginia (C)	460	585	456
Rochester, New York (A)	659	915	786
Roswell, New Mexico (A)	616	573	516
Sacramento, California (C)	(a)	305	351
St. Joseph, Missouri (A)	702	834	633
St. Louis, Missouri (C)	527	761	597
Salt Lake City, Utah (A)	915	786	723
San Antonio, Texas (A)	250	272	126
San Diego, California (A)	171	105	165
Sandusky, Ohio (C)	598	829	726
San Francisco, California (C)	271	255	261
Sault Ste. Marie, Michigan (A)	904	1142	978
Savannah, Georgia (A)	230	345	201
Scranton, Pennsylvania (C)	645	839	732
Seattle, Washington (C)	580	513	570
Sheridan, Wyoming (A)	1019	959	978
Shreveport, Louisiana (A)	342	400	270
Sioux City, Iowa (A)	855	1031	870
Spokane, Washington (A)	961	874	819
Springfield, Illinois (C)	582	849	681
Springfield, Missouri (A)	623	804	564
Syracuse, New York (A)	628	887	798
Tacoma, Washington (C)	648	571	588
Terre Haute, Indiana (A)	647	871	615
Toledo, Ohio (A)	668	902	732
Topeka, Kansas (C)	662	773	639
Trenton, New Jersey (C)	544	685	588
Utica, New York (O)	715	1003	781
Valentine, Nebraska (C)	973	940	897
Walla Walla, Washington (C)	859	691	651
Washington, D. C. (C)	478	634	594
Wichita, Kansas (A)	643	758	636
Williston, North Dakota (C)	1000	1214	1137
Winnemucca, Nevada (C)	1013	794	810
Yakima, Washington (A)	952	809	780

(a) Data not available.

Figures in this table, with seven exceptions, based on local weather bureau reports. Exceptions are Utica and Lewiston, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y., and Norman E. Ross, Bursar, Bates College, Lewiston, Me., respectively; Anaconda, Bozeman, Butte, Deer Lodge and Livingston, Mont., through the courtesy of the Montana Power Company.

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USE COR·TEN

Only in Whittington Pumps are the tanks fabricated of high strength, corrosion resistant U. S. S. COR-TEN . . . *one more reason* why the name WHITTINGTON on a pump is your assurance of highest quality.

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SAVE TIME

Every pump is a completely assembled integral unit, requiring less installation time.

SAVE LABOR

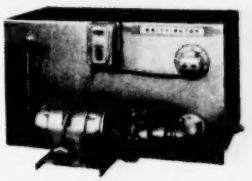
No putting together of individually purchased parts, motors, etc.; installation is simplest of any pump manufactured.

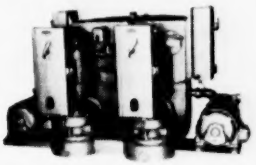
SAVE MONEY

Compact, lighter weight units make for neat appearance, lower freight bills, less installation cost.

Condensation Pumps
single or duplex

Extreme flexibility — close coupled 3450 or 1750 RPM flexible coupled 3450 or 1750 RPM—centrifugal or turbine. Sump type units also available.





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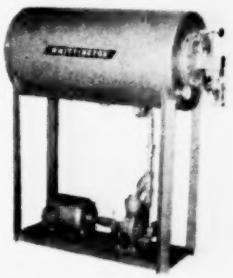
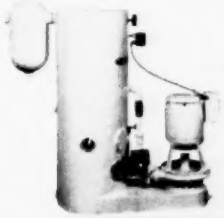
single or duplex

High vacuum water jet principle—2500 to 300,000 sq. ft. E.D.R. Deluxe construction with boiler feed pumps shown. Standard construction with diaphragm discharge valve available. Air capacities automatically increase as system leaks develop.

High Pressure Boiler
Return Systems

Turbine type pumps—pressures to 250 lbs.—single or duplex. Vented tank with dependable make-up water valve. Complete integral unit with suction piping and strainer furnished between receiver and turbine pump.





Clinical Vacuum Pumps
single or duplex

Also combination vacuum-pressure units available. Supplies vacuum or low air pressure for operating rooms. Stainless steel interceptor to catch overflow of body fluids. Quiet operation—washed air—29 HG shut-off at sea level.

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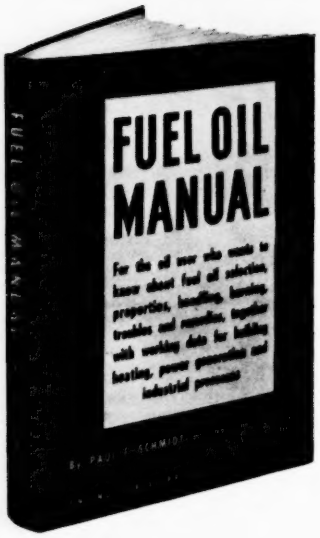

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COMING EVENTS

Where listed, names or titles of individuals are those from whom further information is available.

AUTOMOTIVE ENGINEERS MEETING—Annual meeting and engineering display of the Society of Automotive Engineers, at the Sheraton-Cadillac Hotel, Detroit, Mich. John A. C. Warner, secretary and general manager, 29 West 39th St., New York, N. Y. ..... **JANUARY 12-16 1953.**

PLANT MAINTENANCE SHOW AND CONFERENCE—Plant Maintenance show and conference at the Public Auditorium, Cleveland, Ohio. Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y. ..... **JANUARY 19-22, 1953.**

ASHVE EXPOSITION—The Air Conditioning Exposition, under the auspices of The American Society of Heating and Ventilating Engineers, at the International Amphitheatre, Chicago, Ill. Write to exposition management, International Exposition Co., Inc., Grand Central Palace, New York 17, N. Y. ..... **JANUARY 26-30, 1953.**

ASHVE MEETING—59th annual meeting of the American Society of Heating and Ventilating Engineers, at the Conrad Hilton Hotel, Chicago, Ill. A. V. Hutchinson, secretary of the Society, 62 Worth St., New York 13, N. Y. ..... **JANUARY 26-30, 1953.**

HEATING WHOLESALERS MEETING—The annual meeting of the National Heating Wholesalers Association, Inc., at the Congress Hotel, Chicago, Ill. E. L. Wyman, executive secretary of the Association, 637 Union Commerce Building, Cleveland 14, Ohio ..... **JANUARY 28-30, 1953.**

INSTRUMENT SOCIETY MEETING—Sixth annual Regional Meeting of the Instrument Society of America, at the Hotel Statler, New York, N. Y. Richard Rimbach, 551 5th Ave., New York 17, N. Y. ..... **FEBRUARY 18, 1953.**

TESTING MATERIALS MEETING—Spring meeting of the American Society for Testing Materials, at the Hotel Statler, Detroit, Mich. Secretary of the Society, 1916 Race St., Philadelphia 3, Pa. ..... **MARCH 2-6, 1953.**

CORROSION ENGINEERS EXHIBIT—1953 conference and exhibition of the National Association of Corrosion Engineers, at the Hotel Sherman, Chicago, Ill. Executive secretary of the Association, 1061 M & M Bldg., Houston 2, Texas. ..... **MARCH 16-20, 1953.**

MICHIGAN ENGINEERING MEETING—Annual meeting of the Michigan Engineering Society, at the Kellogg Center Hotel on Michigan State College Campus, East Lansing, Mich. Joseph E. Wilbur, executive secretary of the Society, Rackham Memorial Bldg., Detroit 2, Mich. ..... **APRIL 10-11, 1953.**

MATERIALS HANDLING EXPOSITION—5th National Materials Handling Exposition, sponsored by The Material Handling Institute, at Convention Hall, Philadelphia, Pa. A series of conferences to be held by the American Materials Handling Society concurrently with the exposition. Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y. . . **MAY 18-22, 1953.**

GAMA MEETING—Annual meeting of the Gas Appliance Manufacturers Association, at The Greenbrier Hotel, White Sulphur Springs, West Va. H. Leigh Whitelaw, managing director, 60 E. 42nd St., New York N. Y. ..... **MAY 20-22, 1953.**

NDHA MEETING—44th annual meeting of the National District Heating Association, at Lookout Mountain Hotel, Chattanooga, Tenn. John F. Collins, secretary of the Association, 827 N. Euclid Ave., Pittsburgh 6, Pa. ..... **JUNE 9-12, 1953.**

TESTING MATERIALS MEETING—Annual meeting of the American Society for Testing Materials, at the Chalfonte-Haddon Hall, Atlantic City, N. J. Secretary of the Society, 1916 Race St., Philadelphia 3, Pa. ..... **JUNE 21-25, 1953.**

INSTRUMENT EXHIBIT—8th National Instrument Conference and Exhibit of the Instrument Society of America, in Chicago, Ill. John McCaffery, assistant executive secretary of the Society, 1319 Allegheny Ave., Pittsburgh 33, Pa. ..... **SEPTEMBER 21-25, 1953.**

AGA CONFERENCE—Annual conference of the Amecrian Gas Association, at Kiel Auditorium, St. Louis, Mo. Secretary of the Association, 420 Lexington Ave., New York, N. Y. ..... **OCTOBER 26-29, 1953.**

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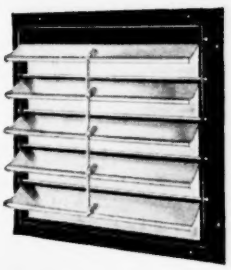

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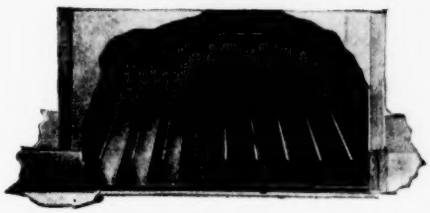

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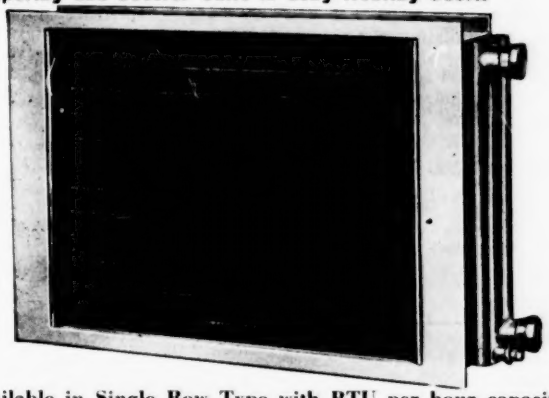

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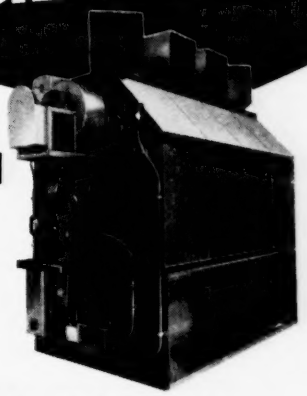

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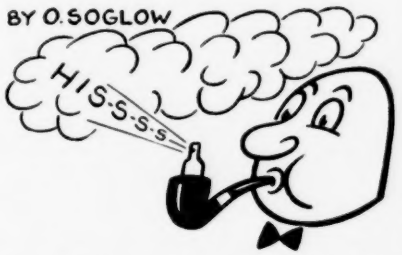

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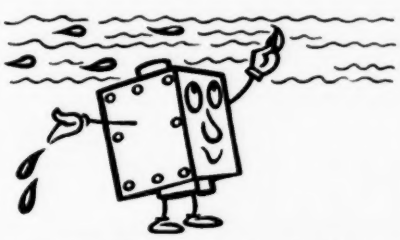

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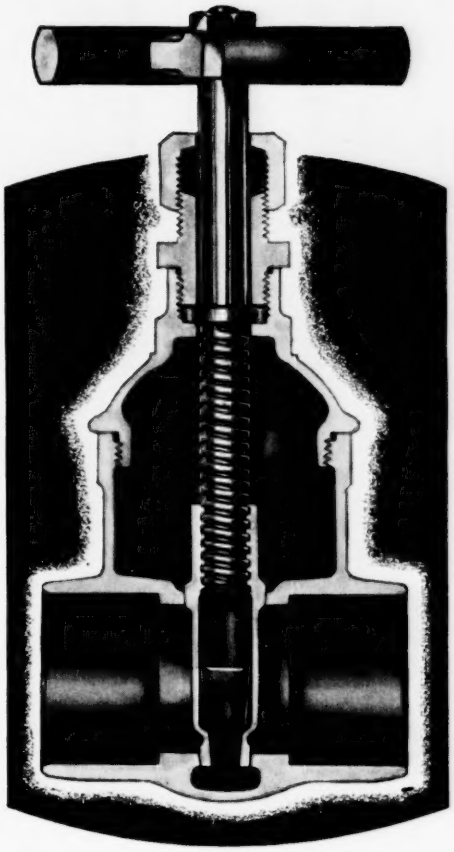

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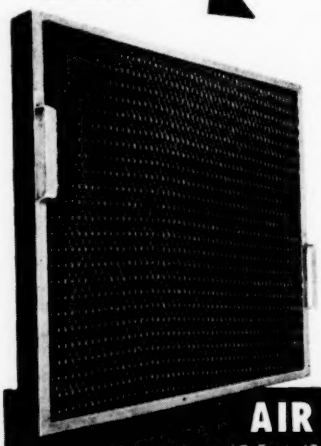

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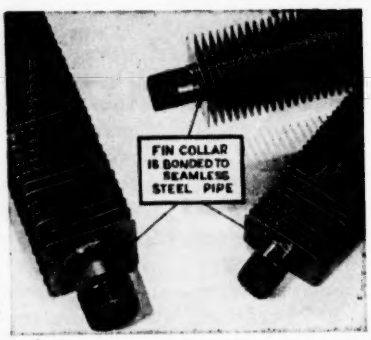

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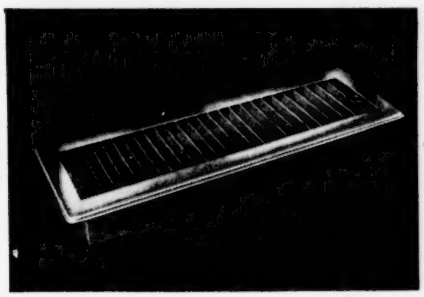

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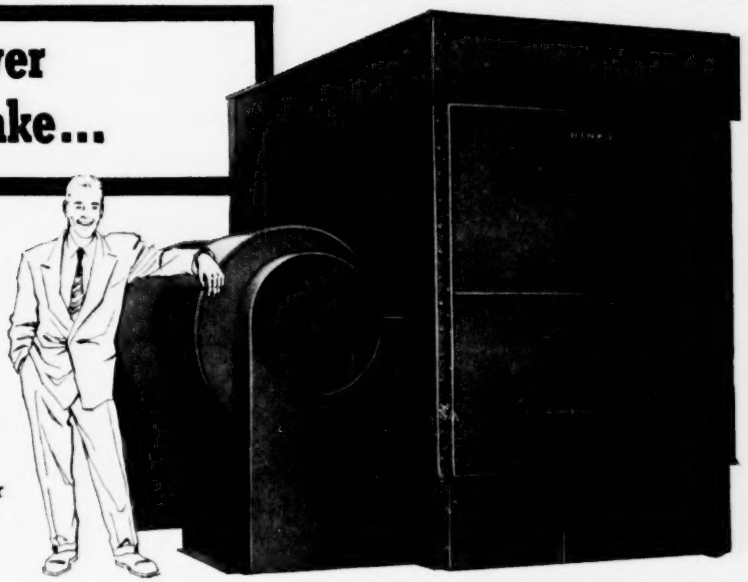

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*Advertisement appeared in preceding issue.

STATIC PRESSURE LOSSES IN DUCT ELEMENTS

The data on losses in static pressure through various duct elements given on the reverse side of this sheet and on a data sheet to follow were compiled by engineers of York Corporation and are presented here by permission.

The first column covers the common types of elements—elbows, transition pieces, entrances, outlets, tees and obstructions in ducts. The second column illustrates the element, the third gives the conditions to which subsequent data apply. The fourth column gives values of n in the formula

$$H_d = nH$$

where H_d is the dynamic loss in inches of water, n the number of velocity heads lost where the air velocity is changed due to passage through a duct element, and H is the velocity head in inches of water.

$$\text{Velocity head } H = \left(\frac{\text{velocity}}{4006}\right)^2$$

The final column gives the loss as equivalent length of straight round duct, and represents average values for velocities up to 2200 ft. per min. and for equivalent duct diameters up to 50 inches.

The total resistance in the duct system is the sum of friction and dynamic resistance in the straight duct and its construction elements plus the resistance through coils, heaters, filters, washers, etc. The resistance through various types of equipment may be supplied by the vendors of these materials.

On comfort cooling projects, the total resistance of the duct system should not exceed around 1.75 inches of water or noise and vibration may be encountered. For industrial systems, higher resistance may be used.

The accompanying table lists recommended maximum air velocities in ducts for different applications.

Example. Air flows at 1800 fpm through a 36 in. round duct. What is the pressure drop through a 90° elbow with a ratio of R/D = 1.0?

Solution. The velocity head is

$$H = \left(\frac{\text{velocity}}{4006}\right)^2 = \left(\frac{1800}{4006}\right)^2 = 0.202 \text{ inches of water}$$

From item 1, reverse side of this sheet, when for a 90° elbow with R/D = 1.0, n = 0.26, so that

$H_d = 0.26 \times 0.202 = 0.0525$ inches of water pressure drop.

The equivalent length of duct can be calculated for specific cases as follows:

RECOMMENDED APPARATUS AND DUCT VELOCITIES

Apparatus	Recommended Velocities in Ft. per Min.
Outside air intakes	800-1000
Through apparatus bypass	1500
Filters	Manufacturer's recommendation
Fin heating coils:	
Preheaters and reheaters	500- 600
Heaters in bypass	800-1000
Air washers and fin cooling coils	400- 650
Fan outlet:	Velocity at max. fan efficiency
Low static pressure (residences)	1000-1500
High static (1 to 2½ in.), moderate to large volumes (commercial air conditioning)	1600-2400

Application	Main Ducts	Branch Ducts
Residences	1000	800
Theatres	1600	1200
Department Stores	1800-2200	1400-1600
General Offices	1800-2000	1200-1500
Private Offices	1500	1000
Restaurants	1800-2000	1500
Small Stores	1600	1200
Hotel Guest Rooms	1600	1000

Example. A friction chart for air in ducts shows that the loss per 100 ft. of 36 inch round duct with air flowing at 1800 fpm is 0.1 inches of water. What is the equivalent loss of the elbow in the preceding example.

Solution. This is solved by proportion

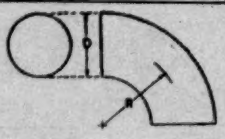
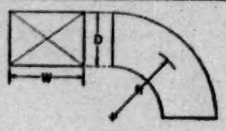
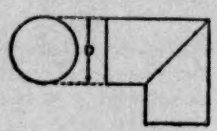
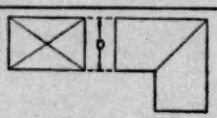
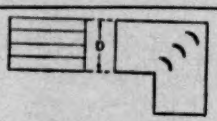
$$\frac{0.1 \text{ inches}}{100 \text{ ft. duct}} = \frac{.0525 \text{ inches}}{Y \text{ ft.}}$$

$$Y = 52.5 \text{ feet.}$$

Since the duct is 3 feet in diameter, the equivalent length expressed in diameters is

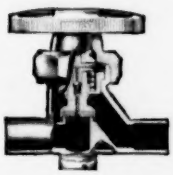
$$\frac{52.5}{3} = 17.5$$

This compares with 15 given in Item 1, reverse side of this sheet, for *average* velocities.

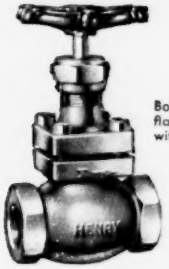
Element	Illustration	Conditions		Value of n	Equivalent Length of Round Duct
1. Round Radius Elbow		$\frac{R}{D} = 0.5$		.73†	43D
		$\frac{R}{D} = 0.75$		.38	23D
		$\frac{R}{D} = 1.0$		.26	15D
		$\frac{R}{D} = 1.5$		.17	10D
		$\frac{R}{D} = 2.0$		.15	9D
2. Rectangular Radius Elbow		$\frac{W}{D}$	$\frac{R}{D}$	*	
		0.5	.5	1.30	79D
			.75	.47	29D
			1.0	.28	17D
			1.5	.18	11D
		1 to 3	.5	.95	57D
			.75	.33	20D
			1.0	.20	12D
			1.5	.13	8D
3. Rectangular Radius Elbow		No. of Vanes	$\frac{R}{D}$	*	
		1	.5	.70	42D
			.75	.16	10D
			1.0	.13	8D
			1.5	.12	7D
		2	.5	.45	27D
			.75	.12	7D
			1.0	.10	6D
			1.5	.15	9D
4. Round Section Mitre Elbow				.87†	53D
5. Rectangular Section Mitre Elbow				1.25*	76D
6. Rectangular Section Square Elbow		Single thickness vanes		.35‡	21D
		Double thickness vanes		Use Manufacturer's Data	
7. Rectangular Tee		Consider equal to an elbow. Base loss on entering air velocity			
8. Radius Tee					

† From F. L. Busey, Trans. A.S.H.V.E., 1913.
* From R. D. Madison and J. R. Parker, Trans. A.S.M.E., 1936.
‡ From A. I. Brown, Power Plant Engineering, 1932.

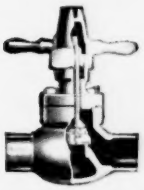
(Concluded on subsequent Reference Data sheet)



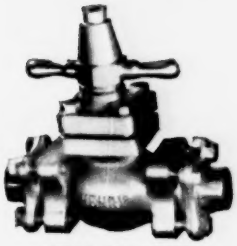
PACKLESS VALVE
With balanced-action



AMMONIA VALVE
Bolted Bonnet — screw or flanged connections. Also with screwed bonnet, sizes 1" and under



WING CAP VALVE
Non-ferrous



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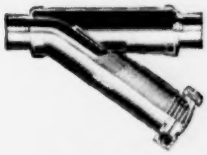
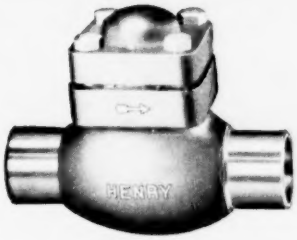


Y-STRAINER
Brass plated. Welded steel construction with forged brass connections. Size ⅝" O. D. S. through 4⅛" O. D. S.

BALANCED-ACTION PACKLESS LIQUID LEVEL GAUGES
Valves are backseating—diaphragms may be inspected or replaced without loss of liquid. Conforms with all safety code requirements.



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Piston Type For Freon. Sizes ⅜" through 4⅛" O.D.S.

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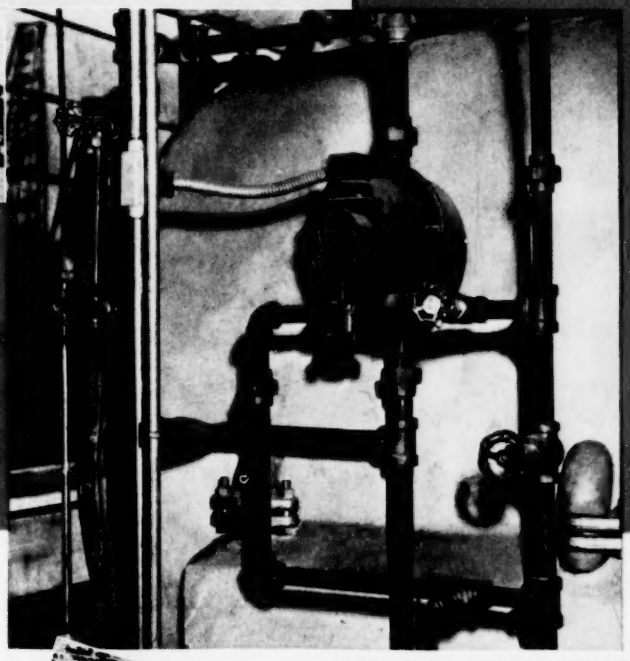

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Well . . . it's like this: That interesting helicopter you're looking at is the tandem rotored Piasecki "Work Horse". It is being produced on a grand scale in the world's newest and largest helicopter plant, and a part, if only a small part of this model factory, is the McDonnell No. 51-2 Feeder-Cut-off installation you see here. This control maintains the water level of a Pacific boiler and keeps it out of low-water trouble.

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